EXHIBIT 10

EXHIBIT C

Infringement Chart for U.S. Patent No. 9,971,678 (Google's Android Studio Tools)

Chart Detailing Defendant's Infringement of U.S. Patent No. 9,971,678

Wapp Tech Ltd. & Wapp Tech Corp. v. J.P. Morgan Chase Bank, N.A.,
Case No. 4:23-cv-1137-ALM (E.D. Tex.)

The Accused Instrumentalities include tools from Google used to develop applications for Android mobile devices, including Android Studio, Android Emulator, Android Virtual Devices, Android Profiler, and Android App Inspection tools.

Based on the information presently available to them, Plaintiffs Wapp Tech Limited Partnership and Wapp Tech Corp. ("Wapp" or "Plaintiffs") are informed and believe that Defendant directly and indirectly infringes U.S. Patent No. 9,971,678 (the "'678 Patent"). Defendant directly infringes the '678 Patent when its employees, agents, and/or representatives use the Accused Instrumentalities to test applications for mobile devices. Upon information and belief, to the extent Defendant uses third parties in the testing process, Defendant indirectly infringes the '678 Patent by actively inducing the direct infringement of third parties contracted to use the Accused Instrumentalities to develop applications for mobile devices on Defendant's behalf.

Infringement Chart for U.S. Patent No. 9,971,678 (Google's Android Studio Tools)

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Infringement Chart for U.S. Patent No. 9,971,678 (Google's Android Studio Tools)

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[A] A system for testing an application for a mobile device comprising:

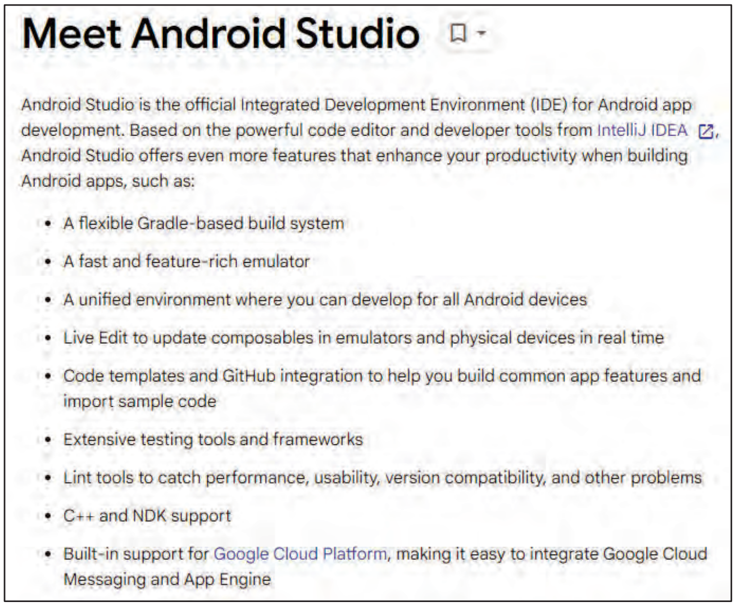
Claim 1

1[A] A system for testing an application for a mobile device comprising:

The Accused Instrumentalities are a system for testing an application for a mobile device. Defendant tests its mobile banking applications through its use of the Accused Instrumentalities by executing compiled source code for the application and monitoring the execution of the source code. Android Studio is software for testing applications based on the Android operating system. The Android operating system runs on various mobile devices, including smartphones, tablets, and wearables. Android Studio includes "[a] fast and feature-rich emulator" and "[e]xtensive testing tools and frameworks."

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[A] A system for testing an application for a mobile device comprising:



Meet Android Studio

Android Studio is the official Integrated Development Environment (IDE) for Android app development. Based on the powerful code editor and developer tools from IntelliJ IDEA, Android Studio offers even more features that enhance your productivity when building Android apps, such as:

- A flexible Gradle-based build system
- A fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Live Edit to update composables in emulators and physical devices in real time
- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- Lint tools to catch performance, usability, version compatibility, and other problems
- C++ and NDK support
- Built-in support for Google Cloud Platform, making it easy to integrate Google Cloud Messaging and App Engine

https://developer.android.com/studio/intro (last visited 4/6/2024).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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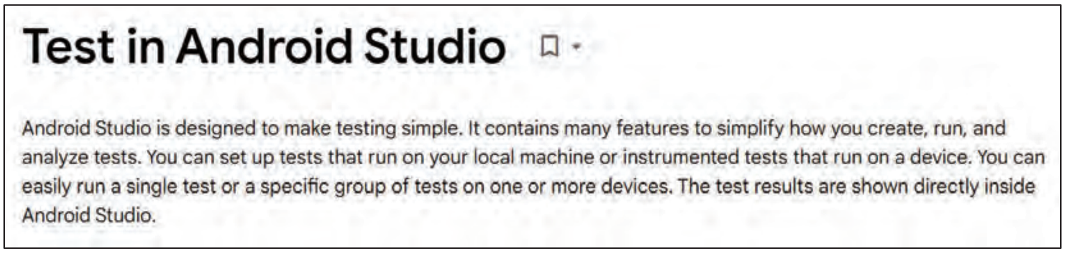
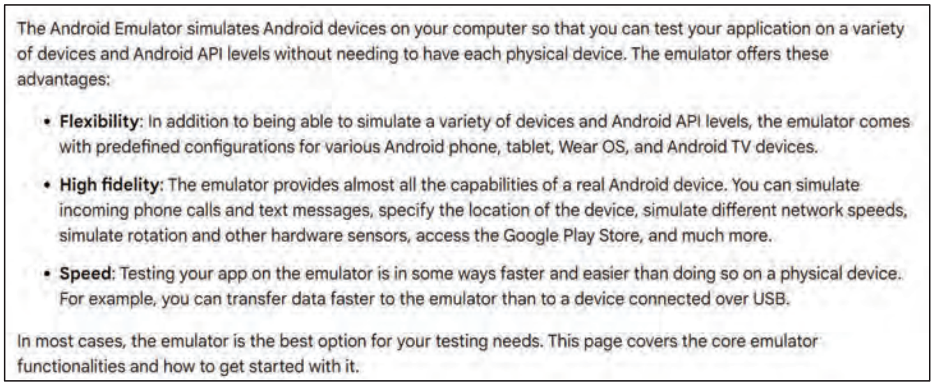


Test in Android Studio

Android Studio is designed to make testing simple. It contains many features to simplify how you create, run, and analyze tests. You can set up tests that run on your local machine or instrumented tests that run on a device. You can easily run a single test or a specific group of tests on one or more devices. The test results are shown directly inside Android Studio.

https://developer.android.com/studio/test/test-in-android-studio (last visited 5/1/2024).

Android Studio includes an emulator for testing mobile device applications. The emulator allows users to "test [their] application on a variety of devices" and "[i]n most cases, the emulator is the best option for your testing needs."



The Android Emulator simulates Android devices on your computer so that you can test your application on a variety of devices and Android API levels without needing to have each physical device. The emulator offers these advantages:

- **Flexibility**: In addition to being able to simulate a variety of devices and Android API levels, the emulator comes with predefined configurations for various Android phone, tablet, Wear OS, and Android TV devices.
- **High fidelity**: The emulator provides almost all the capabilities of a real Android device. You can simulate incoming phone calls and text messages, specify the location of the device, simulate different network speeds, simulate rotation and other hardware sensors, access the Google Play Store, and much more.
- **Speed**: Testing your app on the emulator is in some ways faster and easier than doing so on a physical device. For example, you can transfer data faster to the emulator than to a device connected over USB.

In most cases, the emulator is the best option for your testing needs. This page covers the core emulator functionalities and how to get started with it.

https://developer.android.com/studio/run/emulator (last visited 5/1/24).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

Android Studio includes a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application.

Android Studio includes a software testing interface that is for testing applications based on the Android operating system. Testers use Android Studio to test applications by executing compiled source code for the application and monitoring the execution of the source code. Android Studio includes "[a] fast and feature-rich emulator" and "[e]xtensive testing tools and frameworks."

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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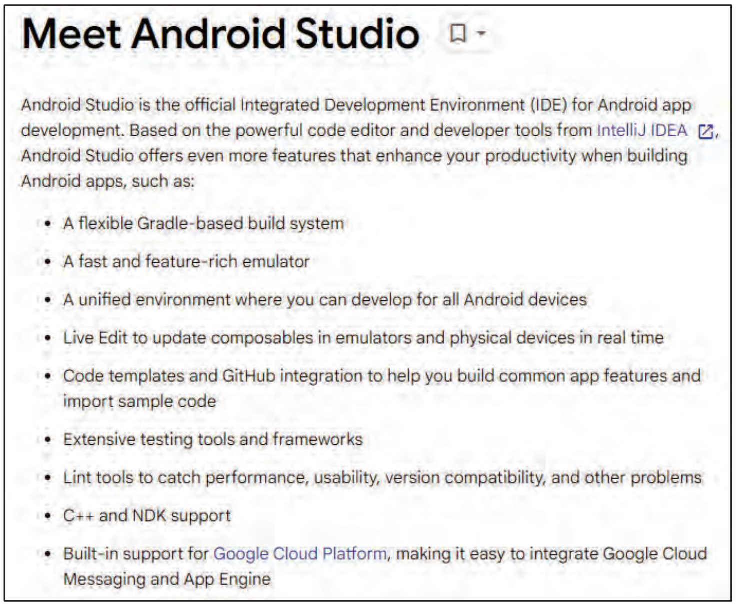

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- A fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Live Edit to update composables in emulators and physical devices in real time
- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- Lint tools to catch performance, usability, version compatibility, and other problems
- C++ and NDK support
- Built-in support for Google Cloud Platform, making it easy to integrate Google Cloud Messaging and App Engine

https://developer.android.com/studio/intro (last visited 4/6/2024).

The following figure illustrates the Android Studio main window that is used for reviewing source code files.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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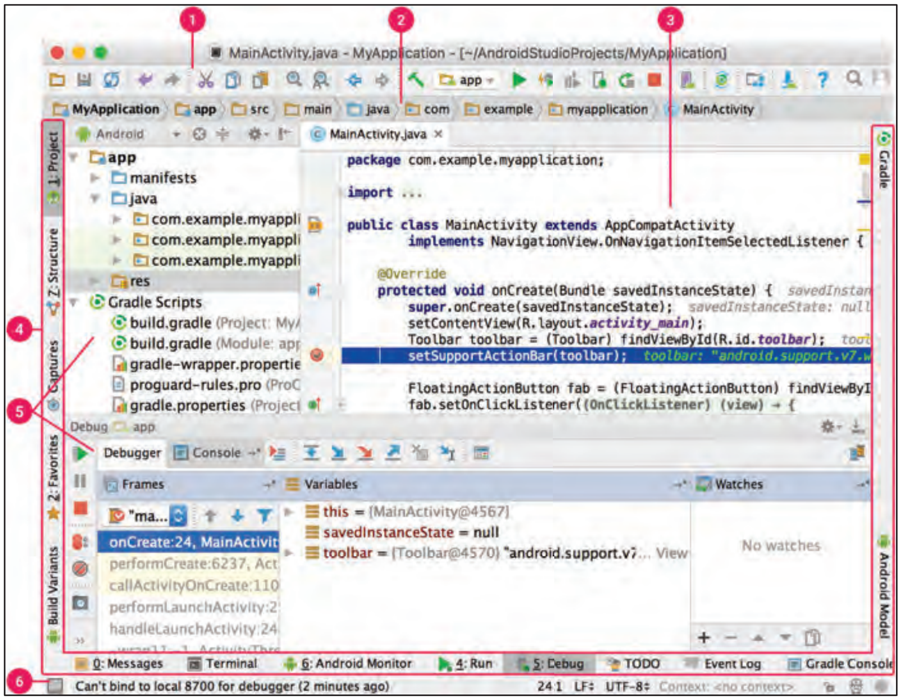


```
package com.example.myapplication;

import ...

public class MainActivity extends AppCompatActivity
        implements NavigationView.OnNavigationItemSelectedListener {

    @Override
    protected void onCreate(Bundle savedInstanceState) {  savedInstan
        super.onCreate(savedInstanceState);  savedInstanceState: null
        setContentView(R.layout.activity_main);
        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);  tool
        setSupportActionBar(toolbar);  toolbar: "android.support.v7.w

        FloatingActionButton fab = (FloatingActionButton) findViewByI
        fab.setOnClickListener((OnClickListener) (view) → {
```

```
onCreate:24, MainActivit
performCreate:6237, Act
callActivityOnCreate:110
performLaunchActivity:2
handleLaunchActivity:24
```

```
this = {MainActivity@4567}
savedInstanceState = null
toolbar = {Toolbar@4570} "android.support.v7... View
```

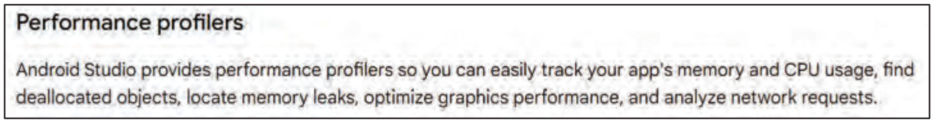
```
Can't bind to local 8700 for debugger (2 minutes ago)        24:1  LF÷  UTF-8÷  Context: <no context>
```

https://developer.android.com/studio/intro (last visited 4/6/2024). The editor window (#3) is used to review source code, which is part of software testing.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

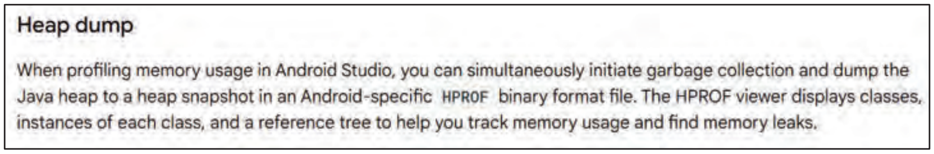
Android Studio's software interface includes a number of different "windows" or tools that are available to the application tester throughout the testing process. These windows include, for example, the performance profilers, heap dump, memory profiler, code inspection tools (e.g., Lint), Android Emulator, and Android Virtual Devices, each of which is described below.



Performance profilers

Android Studio provides performance profilers so you can easily track your app's memory and CPU usage, find deallocated objects, locate memory leaks, optimize graphics performance, and analyze network requests.

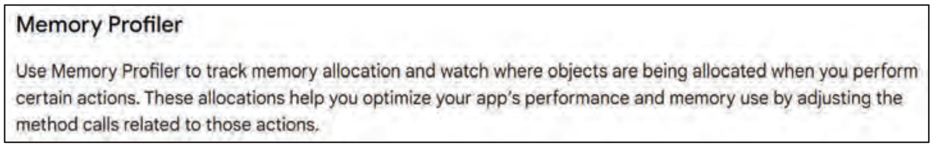
https://developer.android.com/studio/intro (last visited 5/1/2024).



Heap dump

When profiling memory usage in Android Studio, you can simultaneously initiate garbage collection and dump the Java heap to a heap snapshot in an Android-specific `HPROF` binary format file. The HPROF viewer displays classes, instances of each class, and a reference tree to help you track memory usage and find memory leaks.

https://developer.android.com/studio/intro (last visited 5/1/2024).



Memory Profiler

Use Memory Profiler to track memory allocation and watch where objects are being allocated when you perform certain actions. These allocations help you optimize your app's performance and memory use by adjusting the method calls related to those actions.

https://developer.android.com/studio/intro (last visited 5/1/2024).

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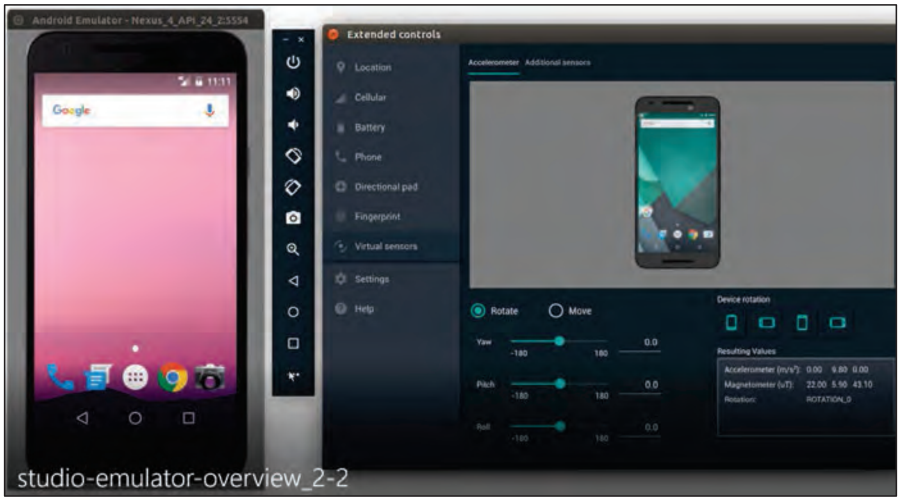

Accelerometer (m/s²): 0.00 9.80 0.00
Magnetometer (uT): 22.00 5.90 43.10
Rotation: ROTATION_0

https://storage.googleapis.com/androiddevelopers/videos/studio-emulator-overview_2-2.mp4 (last visited 5/1/2024) (illustrating Android Emulator).

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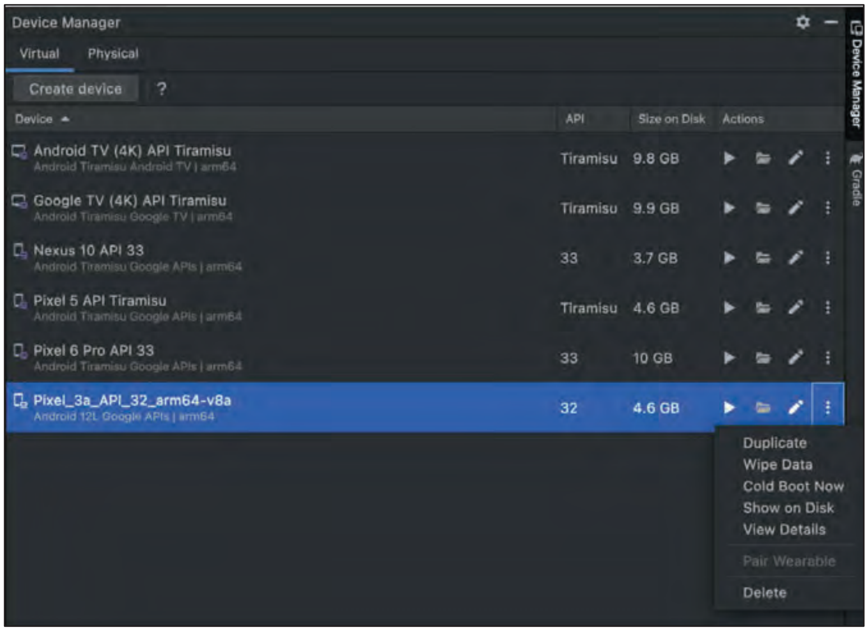

Device ▲	API	Size on Disk	Actions
Android TV (4K) API Tiramisu Android Tiramisu Android TV | arm64	Tiramisu	9.8 GB	▶
Google TV (4K) API Tiramisu Android Tiramisu Google TV | arm64	Tiramisu	9.9 GB	▶
Nexus 10 API 33 Android Tiramisu Google APIs | arm64	33	3.7 GB	▶
Pixel 5 API Tiramisu Android Tiramisu Google APIs | arm64	Tiramisu	4.6 GB	▶
Pixel 6 Pro API 33 Android Tiramisu Google APIs | arm64	33	10 GB	▶
Pixel_3a_API_32_arm64-v8a Android 12L Google APIs | arm64	32	4.6 GB	▶

https://developer.android.com/studio/run/managing-avds (last visited 5/1/2024) (illustrating Android Device Manager).

On information and belief, Defendant uses Android Studio while testing its mobile applications to simulate, via one or more profile display windows, a plurality of network characteristics indicative of performance of the mobile device when executing the application being tested.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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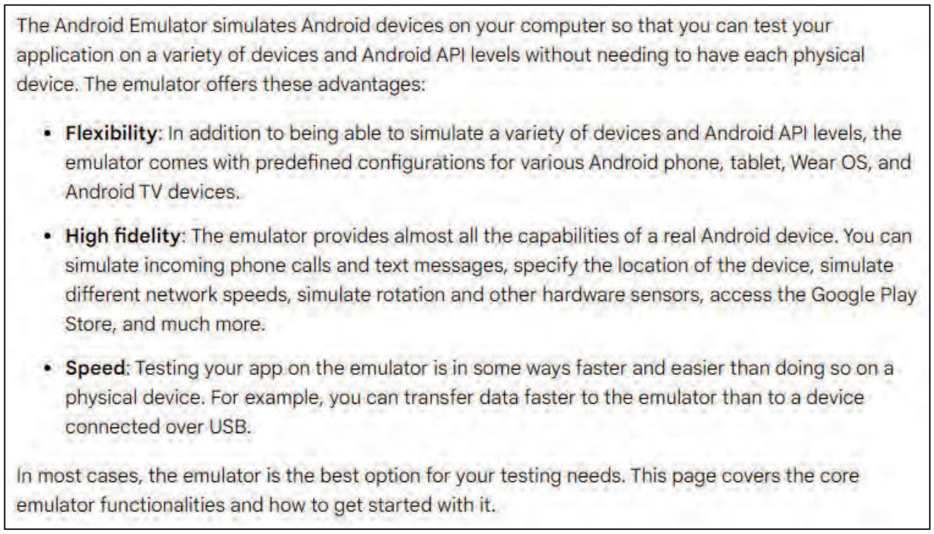
1. Simulate a plurality of network characteristics

Android Studio supports simulation of a plurality of network characteristics through the use of the Android Emulator and Android Virtual Devices (AVDs). The Android Emulator can be used to emulate/simulate Android devices on a computer without actually possessing the physical device. The Android Emulator emulates/simulates "almost all of the capabilities of a real Android device." Android Emulator includes predefined device configurations (or hardware profiles), and it also supports the use of customized device configurations that can be tailored to match the capabilities of a vast array of real-world Android devices.



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https://developer.android.com/studio/run/emulator (last visited 4/6/2024).

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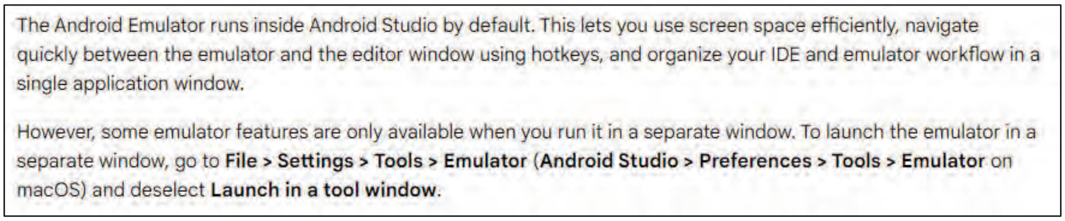
The Android Emulator is available directly within Android Studio and runs inside Android Studio by default. However, the emulator can also be launched in a separate tool window from within Android Studio as well.



The Android Emulator runs inside Android Studio by default. This lets you use screen space efficiently, navigate quickly between the emulator and the editor window using hotkeys, and organize your IDE and emulator workflow in a single application window.

However, some emulator features are only available when you run it in a separate window. To launch the emulator in a separate window, go to **File > Settings > Tools > Emulator** (**Android Studio > Preferences > Tools > Emulator** on macOS) and deselect **Launch in a tool window**.

https://developer.android.com/studio/run/emulator-launch-separate-window (last visited 4/6/2024).

The device being emulated/simulated by Android Emulator is based on an Android Virtual Device (AVD). An AVD specifies the "hardware characteristics" of the device being emulated/simulated. Each AVD specifies the resources of the emulated/simulated device. These AVDs are created and managed in Android Studio using the Android Device Manager.[1]

[1] Prior to the Bumblebee release, Device Manager was referred to as the Android Virtual Device Manager.

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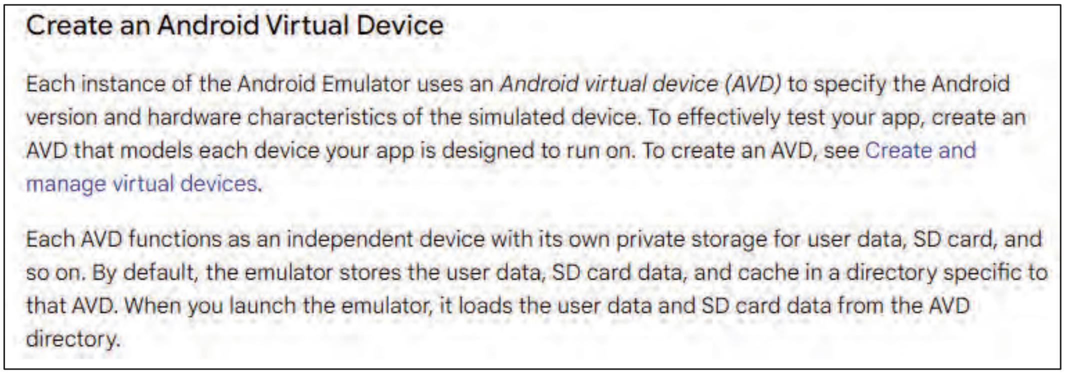

Create an Android Virtual Device

Each instance of the Android Emulator uses an *Android virtual device (AVD)* to specify the Android version and hardware characteristics of the simulated device. To effectively test your app, create an AVD that models each device your app is designed to run on. To create an AVD, see Create and manage virtual devices.

Each AVD functions as an independent device with its own private storage for user data, SD card, and so on. By default, the emulator stores the user data, SD card data, and cache in a directory specific to that AVD. When you launch the emulator, it loads the user data and SD card data from the AVD directory.

https://developer.android.com/studio/run/emulator (last visited 4/6/2024).

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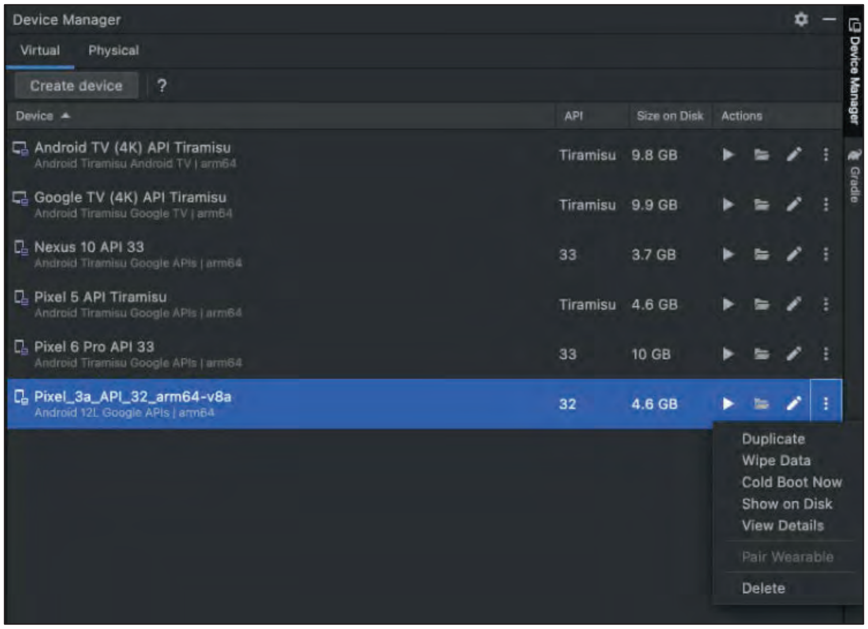

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Pixel_3a_API_32_arm64-v8a Android 12L Google APIs | arm64	32	4.6 GB	

https://developer.android.com/studio/run/managing-avds (last visited 4/6/2024) (illustrating Android Device Manager).

Once an Android Virtual Device is created, its operating properties can be specified. All of these properties are simulated/ emulated during operation within the Emulator.

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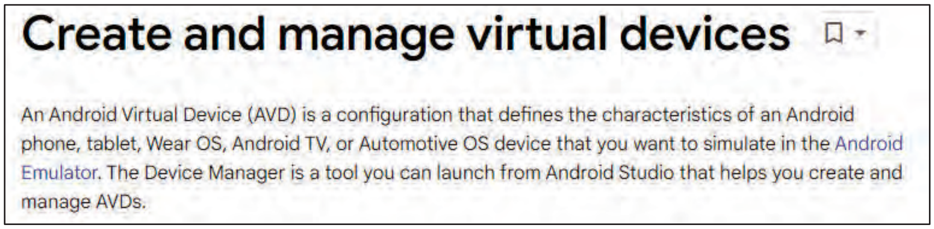

Create and manage virtual devices

An Android Virtual Device (AVD) is a configuration that defines the characteristics of an Android phone, tablet, Wear OS, Android TV, or Automotive OS device that you want to simulate in the Android Emulator. The Device Manager is a tool you can launch from Android Studio that helps you create and manage AVDs.

https://developer.android.com/studio/run/managing-avds (last visited 4/6/2024).

Each Android Virtual Device has a profile that includes a number of properties defining the characteristics of the AVD to emulate/simulate. The "hardware profile properties" include:

- Device Name
- Device Type
- Screen: Screen Size
- Screen: Screen Resolution
- Screen: Round
- Memory: RAM
- Input: Has Hardware Buttons (Back/Home/Menu)
- Input: Has Hardware Keyboard
- Input: Navigation Style
- Supported Device States
- Cameras
- Sensors: Accelerometer
- Sensors: Gyroscope
- Sensors: GPS

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- Sensors: Proximity Sensor
- Default Skin.

See https://developer.android.com/studio/run/managing-avds (last visited 4/6/2024) (listing and describing hardware profile properties). Additionally, an AVD has AVD properties that also control the manner in which the AVD performs during emulation/simulation. The AVD Properties include:

- AVD Name
- AVD ID (Advanced)
- Hardware Profile
- System Image
- Startup Orientation
- Camera (Advanced)
- Network: Speed (Advanced)
- Network: Latency (Advanced)
- Emulated Performance: Graphics
- Emulated Performance: Boot option (Advanced)
- Emulated Performance: Multi-Core CPU (Advanced)
- Memory and Storage: RAM (Advanced)
- Memory and Storage: VM Heap (Advanced)
- Memory and Storage: Internal Storage (Advanced)
- Memory and Storage: SD Card (Advanced)
- Device Frame: Enable Device Frame
- Custom Skin Definition (Advanced)
- Keyboard: Enable Keyboard Input (Advanced)

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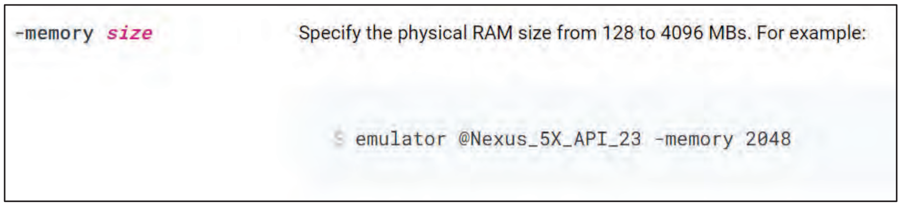
See https://developer.android.com/studio/run/managing-avds (last visited 4/6/2024) (listing and describing AVD properties). Each of the above-mentioned properties are emulated/simulated by Android Emulator when running the device profile specified for that particular AVD. The hardware profile properties and the AVD properties represent device characteristics, including hardware characteristics and network characteristics. When the Emulator runs a particular AVD, these characteristics are emulated/simulated and are indicative of the performance of the emulated/simulated device when testing the application.

Some hardware profile properties and AVD properties can also be controlled via the command-line options available for the Android Emulator. Examples of the command-line options permitting control of hardware characteristics of the AVD device during simulation are provided below.



`-memory size`

Specify the physical RAM size from 128 to 4096 MBs. For example:

```
$ emulator @Nexus_5X_API_23 -memory 2048
```

https://developer.android.com/studio/run/emulator-commandline (last visited 4/6/2024) (showing options for controlling the RAM size of the emulated/simulated device).

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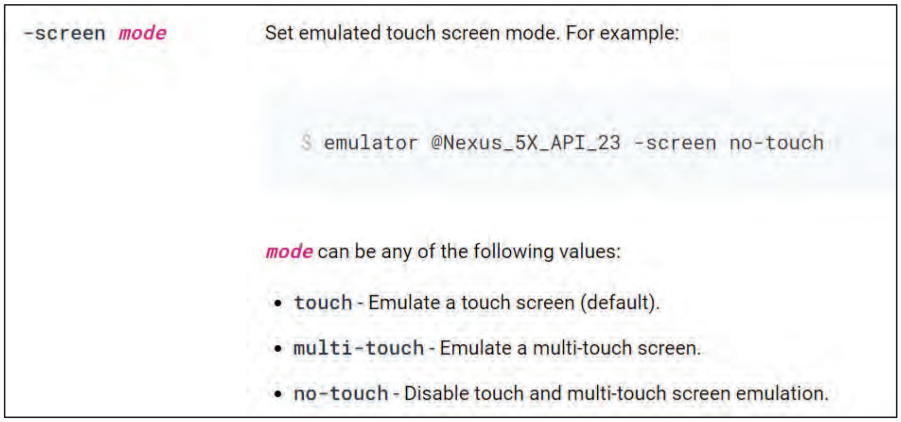


`-screen mode` Set emulated touch screen mode. For example:

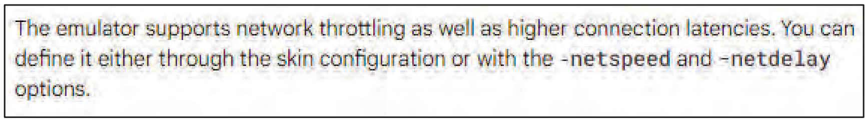
```
$ emulator @Nexus_5X_API_23 -screen no-touch
```

mode can be any of the following values:

- `touch` - Emulate a touch screen (default).
- `multi-touch` - Emulate a multi-touch screen.
- `no-touch` - Disable touch and multi-touch screen emulation.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/6/2024) (showing options for controlling the touch capabilities to emulate/simulate for the device screen).

The Android Emulator is programmed to emulate a plurality of network characteristics, such as network speed (upload/download) and network latency.



The emulator supports network throttling as well as higher connection latencies. You can define it either through the skin configuration or with the `-netspeed` and `-netdelay` options.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/6/2024).

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The following figures show screenshots of the configuration screens for an Android Virtual Device. The first figure shows how an AVD can have a specific network speed associated with it, the speed options including: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM.

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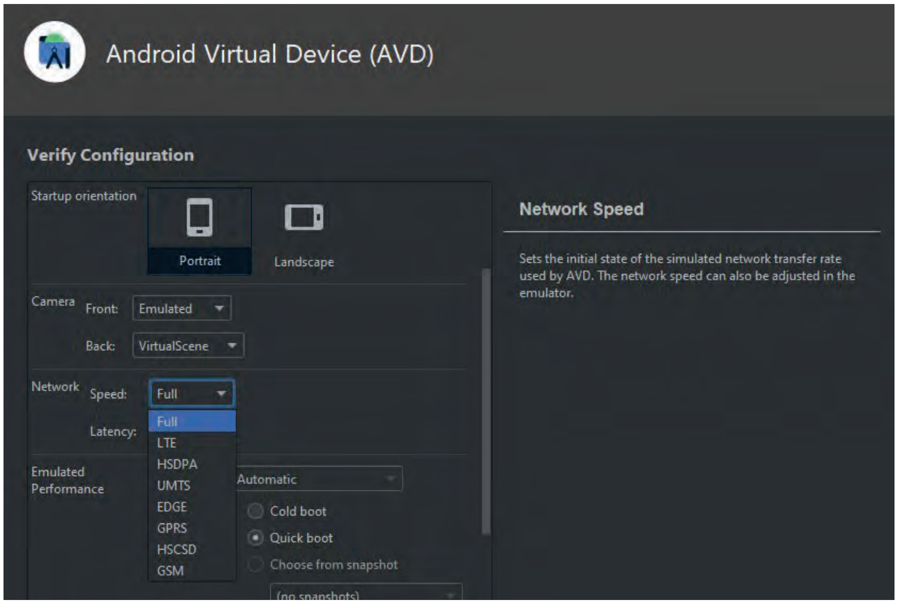


Android Virtual Device (AVD)

Verify Configuration

Startup orientation: Portrait / Landscape

Camera Front: Emulated

Back: VirtualScene

Network Speed: Full

Latency:

Emulated Performance: Automatic

○ Cold boot

● Quick boot

○ Choose from snapshot

(no snapshots)

Network Speed

Sets the initial state of the simulated network transfer rate used by AVD. The network speed can also be adjusted in the emulator.

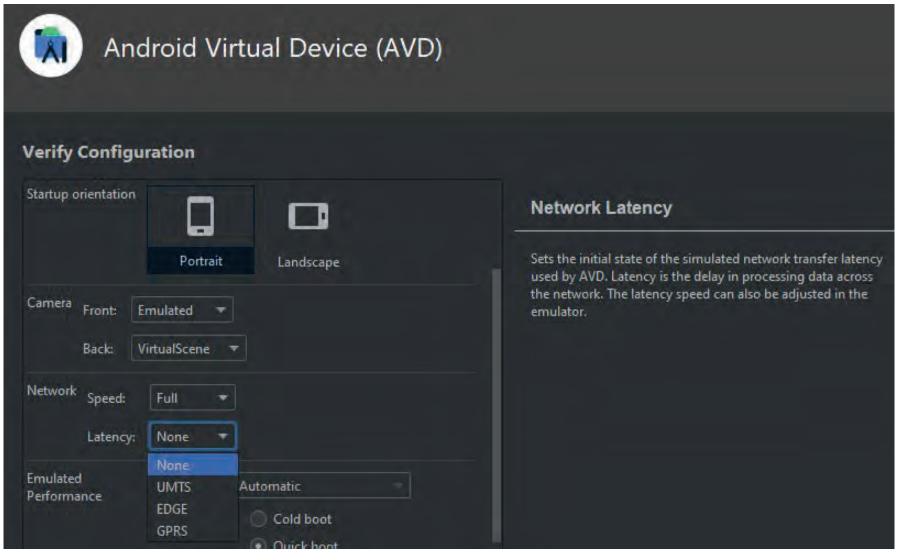
Screenshot from Android Studio Arctic Fox[2]: Android Virtual Device (showing Network Speed options: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM).

[2] New versions of Android Studio are released on a regular basis. The user interface may differ slightly between different versions; however, the functionality identified in this chart exists in Android Studio versions from 2017 to the present. To the extent the functionality in different versions of Android Studio changes in a meaningful way regarding the infringement read, those changes will be noted in the chart.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

The following screenshot shows how an AVD can have a specific network latency associated with it, the latency options including, for example: None, UMTS, EDGE, GPRS.



Android Virtual Device (AVD)

Verify Configuration

Startup orientation: Portrait

Camera Front: Emulated

Back: VirtualScene

Network Speed: Full

Latency: None

Emulated Performance: Automatic

Network Latency

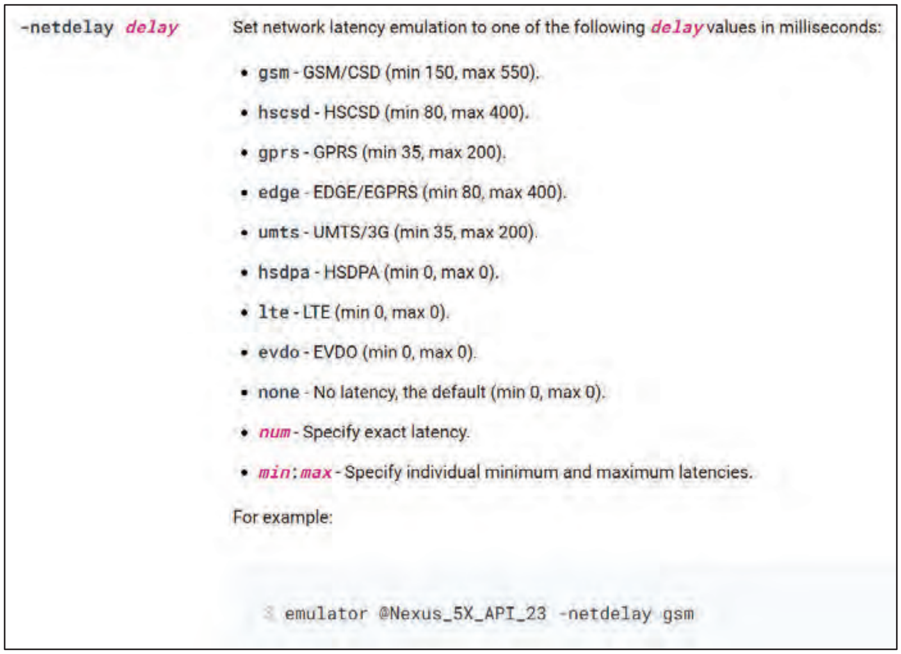
Sets the initial state of the simulated network transfer latency used by AVD. Latency is the delay in processing data across the network. The latency speed can also be adjusted in the emulator.

Screenshot from Android Studio Arctic Fox: Android Virtual Device (showing Network Latency options).

The network characteristics can also be controlled via the command-line options available for the Android Emulator, as illustrated below.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;



`-netdelay delay` Set network latency emulation to one of the following *delay* values in milliseconds:

- gsm - GSM/CSD (min 150, max 550).
- hscsd - HSCSD (min 80, max 400).
- gprs - GPRS (min 35, max 200).
- edge - EDGE/EGPRS (min 80, max 400).
- umts - UMTS/3G (min 35, max 200).
- hsdpa - HSDPA (min 0, max 0).
- lte - LTE (min 0, max 0).
- evdo - EVDO (min 0, max 0).
- none - No latency, the default (min 0, max 0).
- *num* - Specify exact latency.
- *min*:*max* - Specify individual minimum and maximum latencies.

For example:

```
$ emulator @Nexus_5X_API_23 -netdelay gsm
```

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network latency properties).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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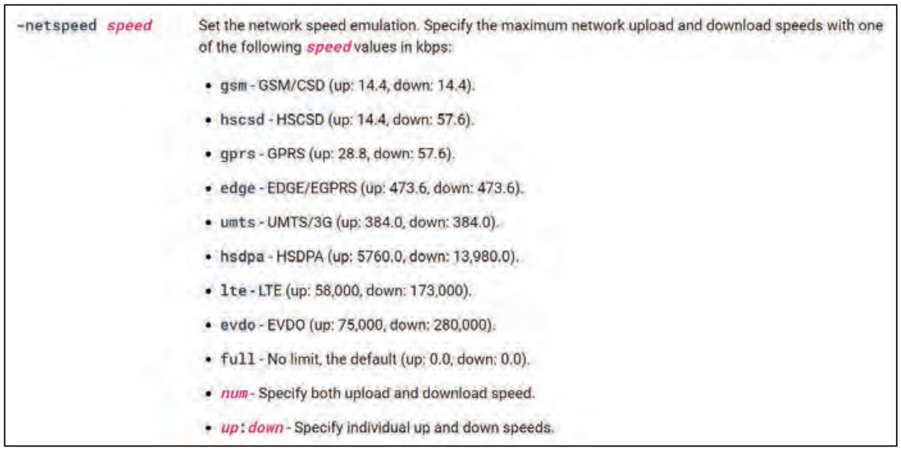


`-netspeed` *speed* Set the network speed emulation. Specify the maximum network upload and download speeds with one of the following *speed* values in kbps:

- `gsm` - GSM/CSD (up: 14.4, down: 14.4).
- `hscsd` - HSCSD (up: 14.4, down: 57.6).
- `gprs` - GPRS (up: 28.8, down: 57.6).
- `edge` - EDGE/EGPRS (up: 473.6, down: 473.6).
- `umts` - UMTS/3G (up: 384.0, down: 384.0).
- `hsdpa` - HSDPA (up: 5760.0, down: 13,980.0).
- `lte` - LTE (up: 58,000, down: 173,000).
- `evdo` - EVDO (up: 75,000, down: 280,000).
- `full` - No limit, the default (up: 0.0, down: 0.0).
- *num* - Specify both upload and download speed.
- *up*:*down* - Specify individual up and down speeds.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network speed properties). The network speed options include an upload and download maximum. Based on these maximum values, a user knows the bandwidth availability being simulated for each network speed property option.

These network characteristics (e.g., speed and latency) are indicative of the performance of a mobile device, affecting the speed and latency with which it can communicate over a network connection while executing the application.

2. Profile display windows

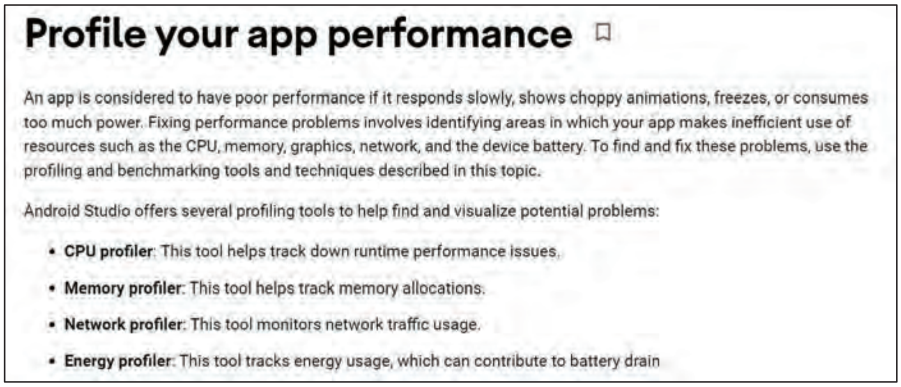
Android Studio includes a number of profiling tools that support application testing, allowing a software tester to monitor the resources of the Android device or AVD that are used by and available to the application while executing on the device. These profiling tools have corresponding display windows.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

The Android profiling tools for Arctic Fox and relevant prior releases include: (1) CPU Profiler; (2) Memory Profiler; (3) Network Profiler; and (4) Energy Profiler. Starting with the Bumblebee release, the Network Profiler was moved to App Inspection and renamed the Network Inspector, as detailed further below.

These profiling tools are used for "[f]ixing performance problems [which] involves identifying areas in which your app makes inefficient use of resources such as the CPU, memory, graphics, network, and the device battery . . . . Android studio offers several profiling tools to help find and visualize potential problems."



Profile your app performance

An app is considered to have poor performance if it responds slowly, shows choppy animations, freezes, or consumes too much power. Fixing performance problems involves identifying areas in which your app makes inefficient use of resources such as the CPU, memory, graphics, network, and the device battery. To find and fix these problems, use the profiling and benchmarking tools and techniques described in this topic.

Android Studio offers several profiling tools to help find and visualize potential problems:

- **CPU profiler**: This tool helps track down runtime performance issues.
- **Memory profiler**: This tool helps track memory allocations.
- **Network profiler**: This tool monitors network traffic usage.
- **Energy profiler**: This tool tracks energy usage, which can contribute to battery drain

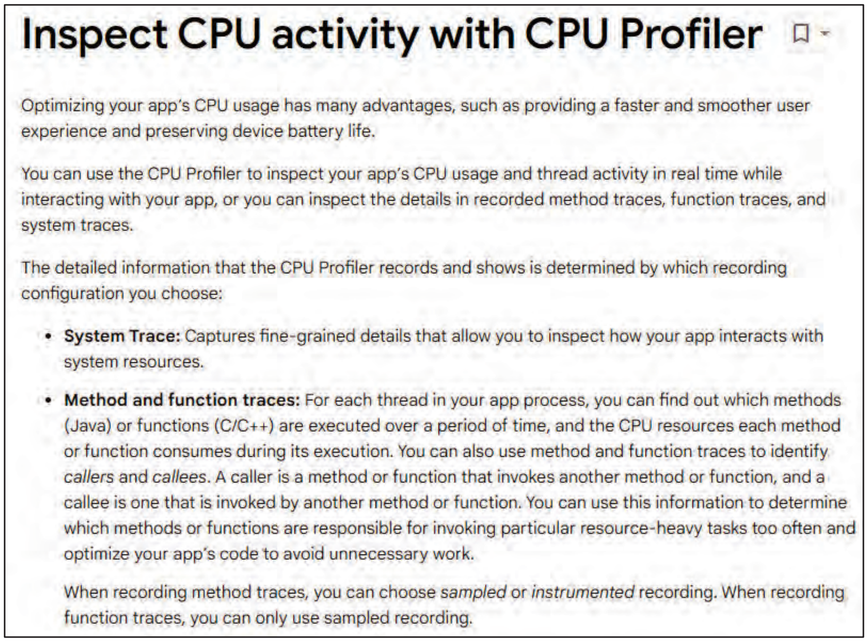
https://developer.android.com/studio/profile (last visited 1/6/2022).

Android Studio allows the application tester to profile the CPU, memory usage, network activity, and energy use of the mobile device while executing and testing an application. Each profiler is detailed below.

The **CPU Profiler** is used to monitor CPU usage and availability, and it helps track down runtime performance issues. It can be used to "inspect your app's CPU usage and thread activity in real time while interacting with your app . . . ."

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;



Inspect CPU activity with CPU Profiler

Optimizing your app's CPU usage has many advantages, such as providing a faster and smoother user experience and preserving device battery life.

You can use the CPU Profiler to inspect your app's CPU usage and thread activity in real time while interacting with your app, or you can inspect the details in recorded method traces, function traces, and system traces.

The detailed information that the CPU Profiler records and shows is determined by which recording configuration you choose:

- **System Trace:** Captures fine-grained details that allow you to inspect how your app interacts with system resources.
- **Method and function traces:** For each thread in your app process, you can find out which methods (Java) or functions (C/C++) are executed over a period of time, and the CPU resources each method or function consumes during its execution. You can also use method and function traces to identify *callers* and *callees*. A caller is a method or function that invokes another method or function, and a callee is one that is invoked by another method or function. You can use this information to determine which methods or functions are responsible for invoking particular resource-heavy tasks too often and optimize your app's code to avoid unnecessary work.

  When recording method traces, you can choose *sampled* or *instrumented* recording. When recording function traces, you can only use sampled recording.

https://developer.android.com/studio/profile/cpu-profiler (last visited 4/7/2024) (detailing the CPU Profiler). The CPU Profiler displays the executed application's CPU usage, CPU availability, and thread activity via timelines, as illustrated below.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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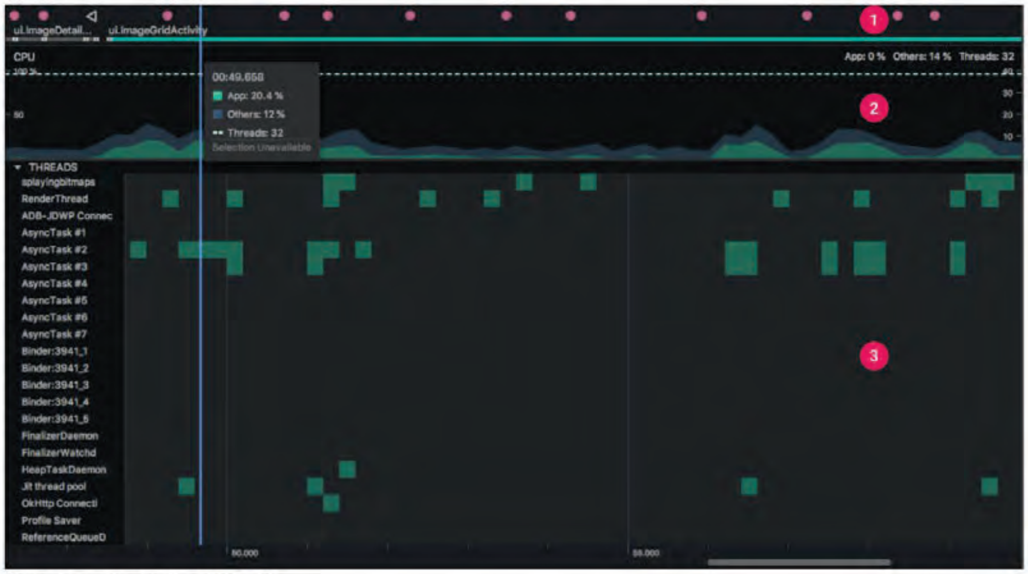


Figure 1. Timelines in the CPU Profiler.

https://developer.android.com/studio/profile/cpu-profiler (last visited 4/7/2024) (illustrating the CPU Profiler timelines).

Referring to the numbers in the figure above, Number 1 illustrates the Event Timeline, which "[s]hows the activities in your app as they transition through different states in their lifecycle, and indicates user interactions with the device, including screen rotation events." *Id.* Number 2 illustrates the CPU Timeline, which "[s]hows real-time CPU usage of your app—as a percentage of total available CPU time—and the total number of threads your app is using. The timeline also shows the CPU usage of other processes (such as system processes or other apps), so you can compare it to your app's usage. You can inspect historical CPU usage data by moving your mouse

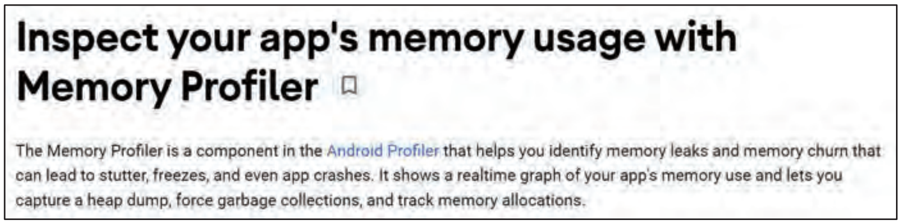
Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

along the horizontal axis of the timeline." *Id.* Finally, Number 3 indicates the Thread Activity Timeline, which "[l]ists each thread that belongs to your app process and indicates its activity along a timeline using the colors listed below." *Id.*

The CPU Timeline (Number 2) shows the CPU usage of the application and CPU availability during execution. In particular, the lighter green portions of the CPU timeline illustrate the percentage of CPU resources used by the application at any given point in time. The darker green/gray portion of the timeline shows the CPU resources consumed by other components on the device (e.g., system processes or other applications). Finally, the remaining dark/black portion of the timeline shows the amount of CPU resources available to the application. The dotted white line across the top of the CPU Timeline shows the 100% mark, indicating the maximum CPU resources available for consumption.

The **Memory Profiler** is used to monitor memory usage by the application as well as memory available to the application. It assists with detecting unwanted or unnecessary memory consumption, including memory leaks and memory churn.



Inspect your app's memory usage with Memory Profiler

The Memory Profiler is a component in the Android Profiler that helps you identify memory leaks and memory churn that can lead to stutter, freezes, and even app crashes. It shows a realtime graph of your app's memory use and lets you capture a heap dump, force garbage collections, and track memory allocations.

https://developer.android.com/studio/profile/memory-profiler (last visited 2/7/2024) (describing the Memory Profiler). An example view of the Memory Profiler is provided below:

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

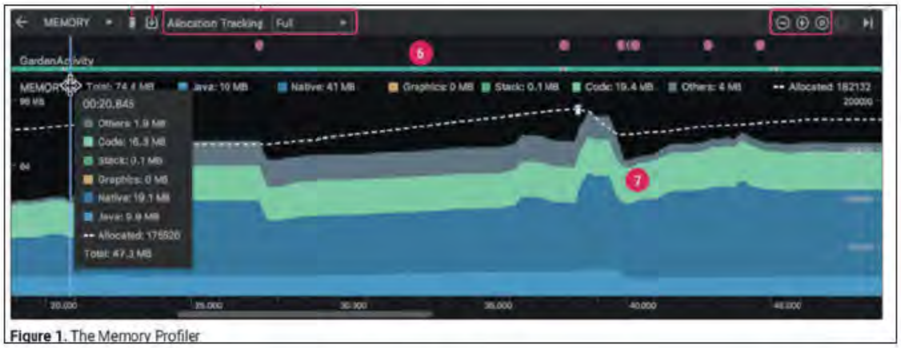


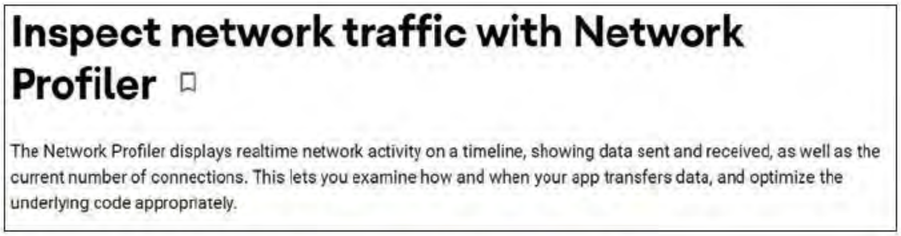
Figure 1. The Memory Profiler

https://developer.android.com/studio/profile/memory-profiler (last visited 4/7/2024) (illustrating the Memory Profiler). The memory legend near the top illustrates the amount of memory consumed or utilized by the application (e.g., Total, Java, Native, Graphics, Stack, Code, Others). Based on the AVD memory limit, this also indicates the total memory resources (unallocated and/or allocated) available to the application (i.e., hardware profile memory available minus total consumed). In addition, the Allocated component (represented in the graph by a white dotted line) indicates the amount of allocated memory resources currently available to the application. Further, the AVD includes a limit on the amount of memory (unallocated and/or allocated) available to the application while being simulated/emulated on the AVD device. In this way, the Memory Profiler provides information about the unallocated and allocated memory resources available to and utilized by an application for a given AVD configuration.

The **Network Profiler** allows the application author to monitor network connections and data exchanges by the mobile application.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;



Inspect network traffic with Network Profiler

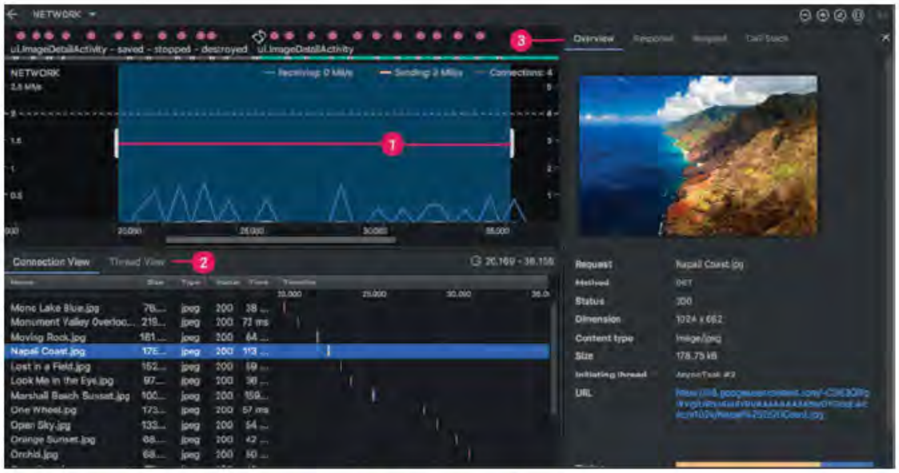
The Network Profiler displays realtime network activity on a timeline, showing data sent and received, as well as the current number of connections. This lets you examine how and when your app transfers data, and optimize the underlying code appropriately.

https://developer.android.com/studio/profile/network-profiler (last visited 1/6/2022).

As illustrated below, the Network Profiler shows the receiving network speed, the sending network speed, and latency.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;



Name	Size	Type	Status	Time	Timeline
Mono Lake Blue.jpg	78...	jpeg	200	38 ...	
Monument Valley Overloo...	219...	jpeg	200	72 ms	
Moving Rock.jpg	181 ...	jpeg	200	64 ...	
Napali Coast.jpg	176...	jpeg	200	113 ...	
Lost in a Field.jpg	152...	jpeg	200	59 ...	
Look Me in the Eye.jpg	97...	jpeg	200	38 ...	
Marshall Beach Sunset.jpg	100...	jpeg	200	159...	
One Wheel.jpg	173...	jpeg	200	57 ms	
Open Sky.jpg	133...	jpeg	200	54 ...	
Orange Sunset.jpg	68...	jpeg	200	42 ...	
Orchid.jpg	68...	jpeg	200	50 ...	

Request	Napali Coast.jpg
Method	GET
Status	200
Dimension	1024 x 662
Content type	image/jpeg
Size	178.75 kB
Initiating thread	AsyncTask #2
URL	[illegible]

https://developer.android.com/studio/profile/network-profiler (last visited 7/27/2021).

The Connection View provides additional information about the network transmissions, including transmission duration and timing, which is related to network latency.

> - **Connection View**: Lists files that were sent or received during the selected portion of the timeline across all of your app's CPU threads. For each request, you can inspect the size, type, status, and transmission duration. You can sort this list by clicking any of the column headers. You also see a detailed breakdown of the selected portion of the timeline, showing when each file was sent or received.

https://developer.android.com/studio/profile/network-profiler (last visited 7/27/2021).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

The Thread View displays the network activity for each of the application's CPU threads, illustrating the receiving network speed, the sending network speed, and latency.

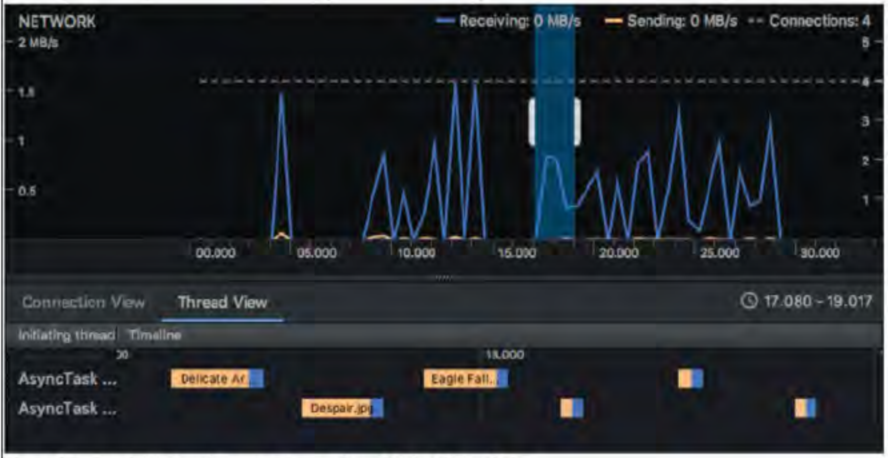


Figure 2. Inspecting network requests by app thread in the **Thread View**

https://developer.android.com/studio/profile/network-profiler (last visited 1/7/2022). The blue line in the network timeline shows the receiving rate of data flow, and the orange line shows the sending rate of data flow for the application. Each of these translate to bandwidth resources used by the application. The dotted line indicates the number of connections and the maximum data transfer rate employed by the application. The indication of a previously seen maximum data rate provides information about the bandwidth resources available to the application.

Additionally, as detailed above, the AVD is configured with network throttling properties that limit the bandwidth—both upload and download speeds—that is available to the application.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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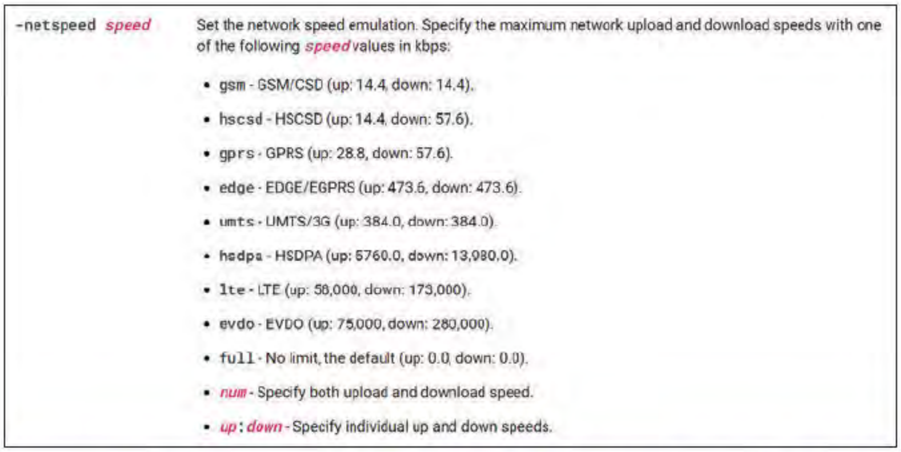

`-netspeed` *speed*

Set the network speed emulation. Specify the maximum network upload and download speeds with one of the following *speed* values in kbps:

- `gsm` - GSM/CSD (up: 14.4, down: 14.4).
- `hscsd` - HSCSD (up: 14.4, down: 57.6).
- `gprs` - GPRS (up: 28.8, down: 57.6).
- `edge` - EDGE/EGPRS (up: 473.6, down: 473.6).
- `umts` - UMTS/3G (up: 384.0, down: 384.0).
- `hsdpa` - HSDPA (up: 5760.0, down: 13,980.0).
- `lte` - LTE (up: 58,000, down: 173,000).
- `evdo` - EVDO (up: 75,000, down: 280,000).
- `full` - No limit, the default (up: 0.0, down: 0.0).
- *num* - Specify both upload and download speed.
- *up*`:`*down* - Specify individual up and down speeds.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/6/2024) (showing the upload and download maximums for different "network speed" settings provided in the AVD configuration). For example, an AVD configured with EDGE network speed is limited to 473.6 kbps upload speed and 473.6 kbps download speed. This provides an upper-bound on the network bandwidth resources available to the application, and the Network Profiler displays the utilized bandwidth per unit time, thus showing the remaining bandwidth available to the application based on its network speed settings.

The **Energy Profiler** allows the author to monitor energy consumption by the application.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

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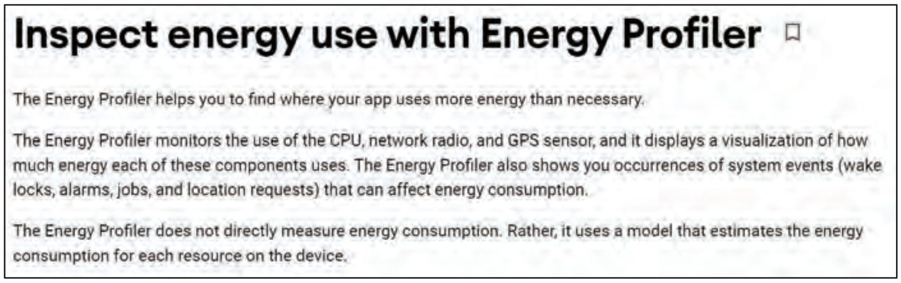


Inspect energy use with Energy Profiler

The Energy Profiler helps you to find where your app uses more energy than necessary.

The Energy Profiler monitors the use of the CPU, network radio, and GPS sensor, and it displays a visualization of how much energy each of these components uses. The Energy Profiler also shows you occurrences of system events (wake locks, alarms, jobs, and location requests) that can affect energy consumption.

The Energy Profiler does not directly measure energy consumption. Rather, it uses a model that estimates the energy consumption for each resource on the device.

https://developer.android.com/studio/profile/energy-profiler (last visited 4/7/2024). An example view of the Energy Profiler is provided below:

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

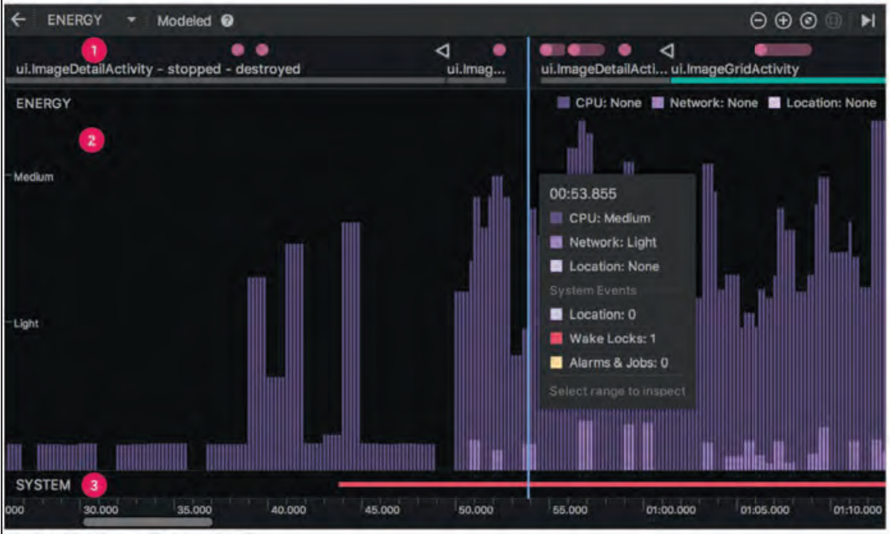


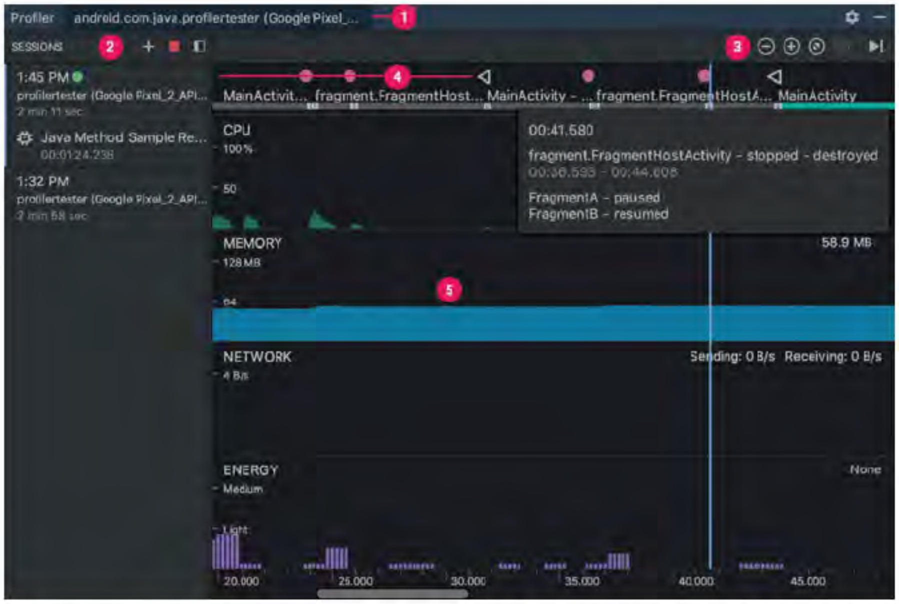
Figure 1. Timelines in the Energy Profiler.

https://developer.android.com/studio/profile/energy-profiler (last visited 4/7/2024). Three timelines are illustrated in this Energy Profiler view. The first (1) is the Event Timeline, which "[s]hows the activities in your app as they transition through different states in their lifecycle. This timeline also indicates user interactions with the device, including screen rotation events." *Id.* The second (2) is the Energy Timeline, which "[s]hows estimated energy consumption of your app." *Id.* And the third (3) is the System Time, which "[i]ndicates system events that may affect energy consumption." *Id.* By moving your mouse over the timelines, you can "see a breakdown of energy use by CPU, network, and location (GPS) resources . . . ." *Id.*

In addition to the exemplary profile display windows illustrated above, Android Studio Arctic Fox (and earlier versions) supports display of profile windows for all four profilers discussed above:

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;

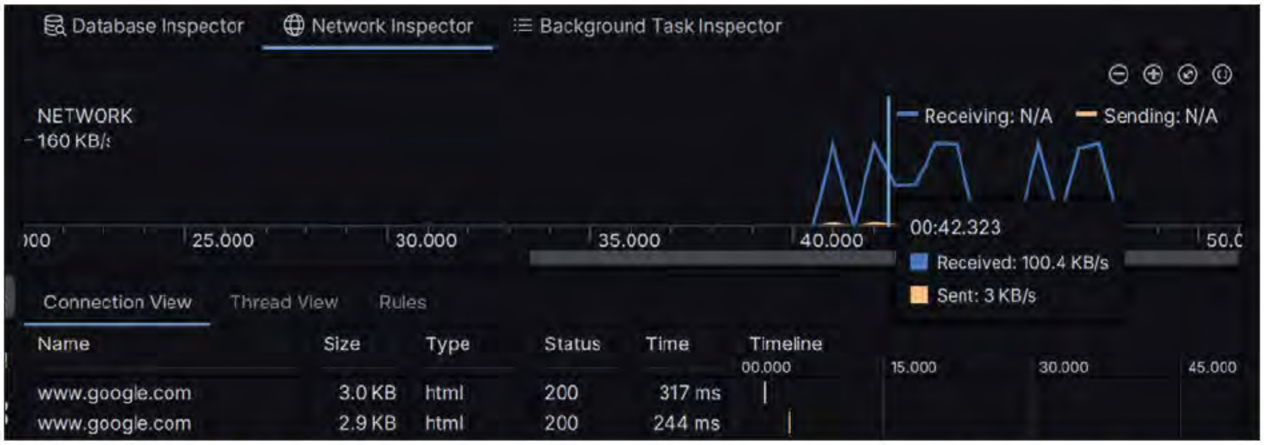

Profiler
android.com.java.profilertester (Google Pixel_...
1
SESSIONS
2
3
1:45 PM
profilertester (Google Pixel_2_API...
2 min 11 sec
Java Method Sample Re...
00:01:24.238
1:32 PM
profilertester (Google Pixel_2_API...
2 min 58 sec
4
MainActivit... fragment.FragmentHost... MainActivity - ... fragment.FragmentHostA... MainActivity
CPU
100 %
50
00:41.580
fragment.FragmentHostActivity - stopped - destroyed
00:36.593 - 00:44.608
FragmentA - paused
FragmentB - resumed
MEMORY
128 MB
64
5
58.9 MB
NETWORK
4 B/s
Sending: 0 B/s Receiving: 0 B/s
ENERGY
Medium
Light
None
20.000
25.000
30.000
35.000
40.000
45.000

https://developer.android.com/studio/profile/android-profiler (last visited 7/27/2021) (illustrating the CPU, Memory, Network, and Energy profile displays).

Starting with the Android Studio Bumblebee release, the Network Profiler was moved to the App Inspection component of Android Studio and renamed Network Inspector. *See* https://developer.android.com/studio/releases/past-releases/as-bumblebee-release-notes (last visited 4/20/2024). The Network Inspector view is shown below:

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[B] a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;



Name	Size	Type	Status	Time	Timeline
www.google.com	3.0 KB	html	200	317 ms	
www.google.com	2.9 KB	html	200	244 ms	

Screenshot from Android Studio Iguana (showing Network Inspector). The Network Inspector view shows the receiving network speed and the sending network speed. And it includes the Connection View and Thread View discussed above for the Network Profiler.

The CPU and Memory Profilers are available in post-Arctic Fox versions of Android Studio, as detailed above for Arctic Fox.

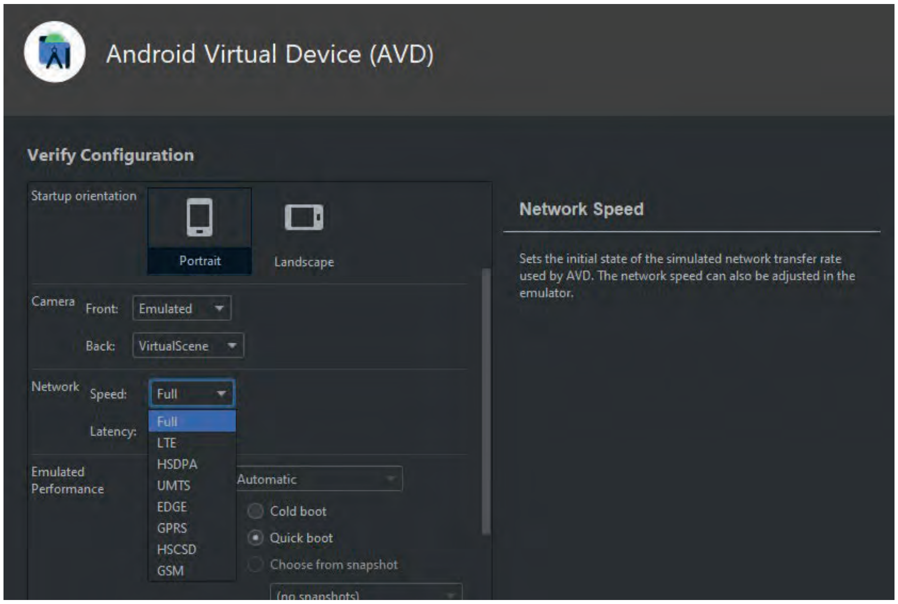
1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.

The bandwidth availability depicted in Android Studio while the Emulator is operating with a Network Speed option is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.

The following figure shows the configuration screen for an Android Virtual Device and how an AVD can have a specific network speed associated with it, the speed options including: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.



Front: Emulated

Back: VirtualScene

Speed: Full

● Quick boot

Sets the initial state of the simulated network transfer rate used by AVD. The network speed can also be adjusted in the emulator.

Screenshot from Android Studio Arctic Fox: Android Virtual Device (showing Network Speed options: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM). These Network Speed options are based on non-simulated environments, such as "LTE" and GSM" networks.

The network speed and latency options are based on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network at least because of their reliance on network standards developed to dictate the operation of real-world networks, such as LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, and GSM.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.

For instance, GSM corresponds to what is often referred to as the "2G" network standard established around 1991. Similarly, EDGE corresponds to Enhanced Data rates for GSM Evolution, an enhancement to GSM. And HSCSD corresponds to High Speed Circuit Switched Data, which is an enhancement to the data rate of circuit switched data in a GSM network. GPRS corresponds to a packet-oriented enhancement to 2G networks—General Packet Radio Service. UMTS is the Universal Mobile Telecommunications System, a new architecture that provided the basis for what is often referred to as the "3G" network standards. HSDPA, or High-Speed Downlink Packet Access, is an enhancement to the 3G network architecture to boost data capacity and improve download rates. Finally, LTE, or Long Term Evolution, represents the transition from 3G to what is typically referred to as "4G" network technology.

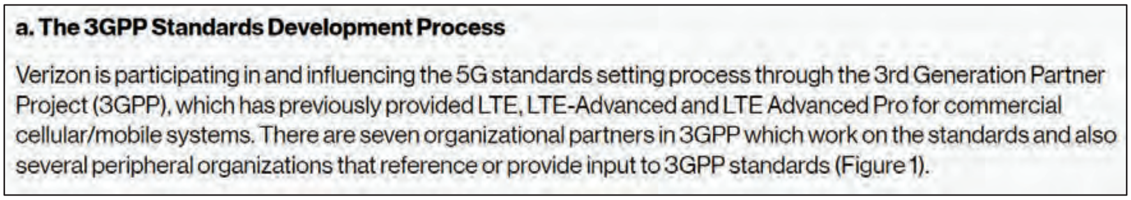
Each of these network standards defines the general operation of the network, and these definitions provide theoretical constraints on the networks' capacity for communication, including bandwidth, latency, and speed constraints. These constraints can be further impaired based on network conditions, including the presence of physical obstacles, electro-magnetic interference, and/or distance between the base station and a mobiles station with which it is communicating.

The development and evolution of these standards relied on data of interactions with real-world implementations of such networks at least for testing and proof-of-concept. Thus, Android Studio's speed and latency constraints correspond to each identified standard, which are based on data of interaction of networks in non-simulated environments.

Many network operators have participated in (and continue to) the cellular standards detailed above. This participation includes both influencing the direction of the standards as well as testing the viability or early implementation of proposed standards.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

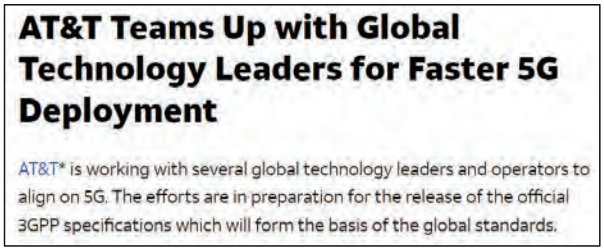
1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.



a. The 3GPP Standards Development Process

Verizon is participating in and influencing the 5G standards setting process through the 3rd Generation Partner Project (3GPP), which has previously provided LTE, LTE-Advanced and LTE Advanced Pro for commercial cellular/mobile systems. There are seven organizational partners in 3GPP which work on the standards and also several peripheral organizations that reference or provide input to 3GPP standards (Figure 1).

https://www.verizon.com/business/resources/whitepapers/first-principles-for-securing-5g/ (last visited 5/17/2024); *see also id.* ("The standards development process, including work on security features, benefits from input from companies with real-world experience deploying new technology. It is common for companies like Verizon who are "first movers" to deploy service using new technology while the standards are still in development.").



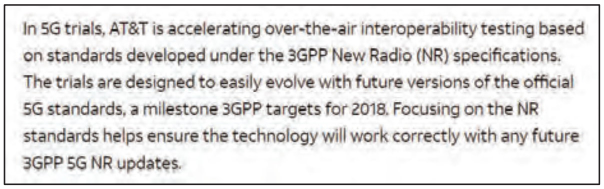
AT&T Teams Up with Global Technology Leaders for Faster 5G Deployment

AT&T* is working with several global technology leaders and operators to align on 5G. The efforts are in preparation for the release of the official 3GPP specifications which will form the basis of the global standards.

....

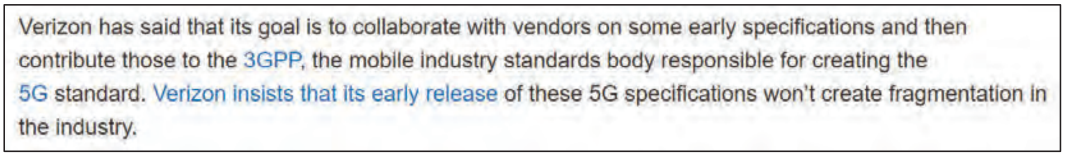
Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.



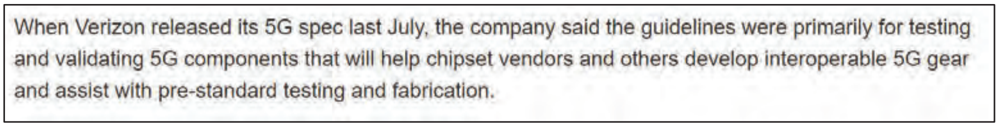
In 5G trials, AT&T is accelerating over-the-air interoperability testing based on standards developed under the 3GPP New Radio (NR) specifications. The trials are designed to easily evolve with future versions of the official 5G standards, a milestone 3GPP targets for 2018. Focusing on the NR standards helps ensure the technology will work correctly with any future 3GPP 5G NR updates.

https://about.att.com/story/faster_5g_deployment.html (last visited 5/17/2024).



Verizon has said that its goal is to collaborate with vendors on some early specifications and then contribute those to the 3GPP, the mobile industry standards body responsible for creating the 5G standard. Verizon insists that its early release of these 5G specifications won't create fragmentation in the industry.

....



When Verizon released its 5G spec last July, the company said the guidelines were primarily for testing and validating 5G components that will help chipset vendors and others develop interoperable 5G gear and assist with pre-standard testing and fabrication.

https://www.sdxcentral.com/articles/news/verizon-att-spar-5g-standards-process/2016/09/ (last visited 5/17/2024).

When Android Studio was first released (2013), wireless networks had been widely deployed by network operators. On information and belief, Android Studio's speed and latency constraints are based on data of interaction with such networks in non-simulated environments operated by network operators.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

1[C] wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.

These protocols are built for use in non-simulated environments, notably, operator networks. Therefore, Android Studio's Network Speed and Latency settings are based on data of interaction between one or more mobile devices at an least one network operator.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.

Claim 2

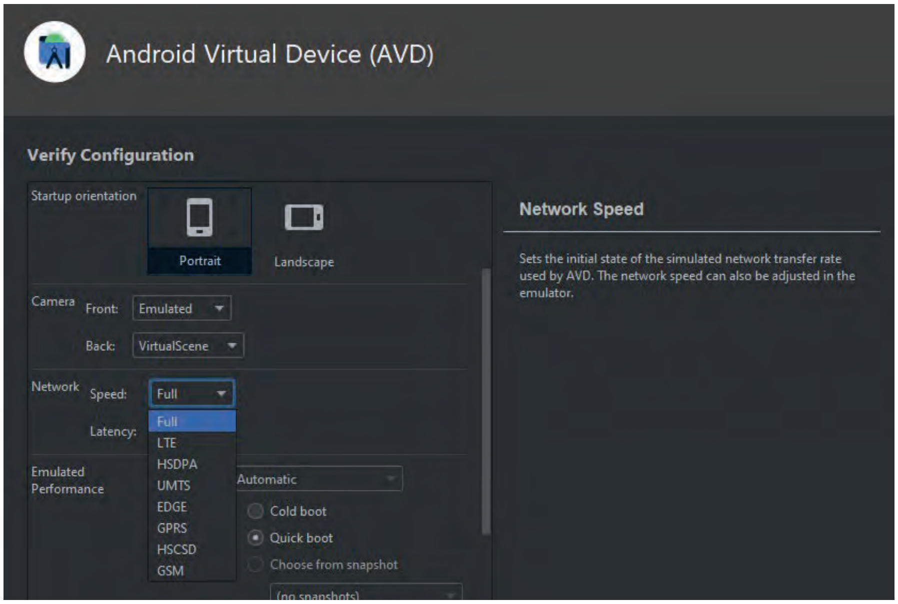
2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.

As discussed above for limitation 1[B].1 (and incorporated here by reference), the software is further configured to enable a user to select from one or more connection simulations by specifying network speed and network latency for testing how well mobile content (such as that generated by the application being tested) performs on the mobile device.

The following figures show screenshots of the configuration screens for an Android Virtual Device. The first figure shows how an AVD can have a specific network speed associated with it, the speed options including: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM.

<u>Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)</u>

2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.



Android Virtual Device (AVD)

Verify Configuration

Startup orientation: Portrait

Camera Front: Emulated

Back: VirtualScene

Network Speed: Full

Latency:

Emulated Performance: Automatic

○ Cold boot

● Quick boot

○ Choose from snapshot

(no snapshots)

Network Speed

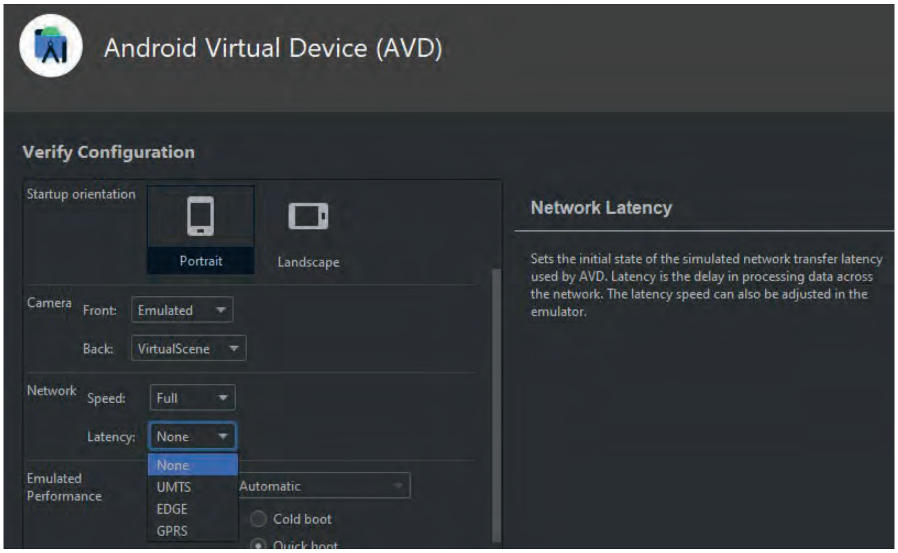
Sets the initial state of the simulated network transfer rate used by AVD. The network speed can also be adjusted in the emulator.

Screenshot from Android Studio Arctic Fox: Android Virtual Device (showing Network Speed options: Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM).

The following screenshot shows how an AVD can have a specific network latency associated with it, the latency options including, for example: None, UMTS, EDGE, GPRS.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.



Android Virtual Device (AVD)

Verify Configuration

Startup orientation: Portrait | Landscape

Camera Front: Emulated

Back: VirtualScene

Network Speed: Full

Latency: None

None
UMTS
EDGE
GPRS

Emulated Performance: Automatic

○ Cold boot

● Quick boot

Network Latency

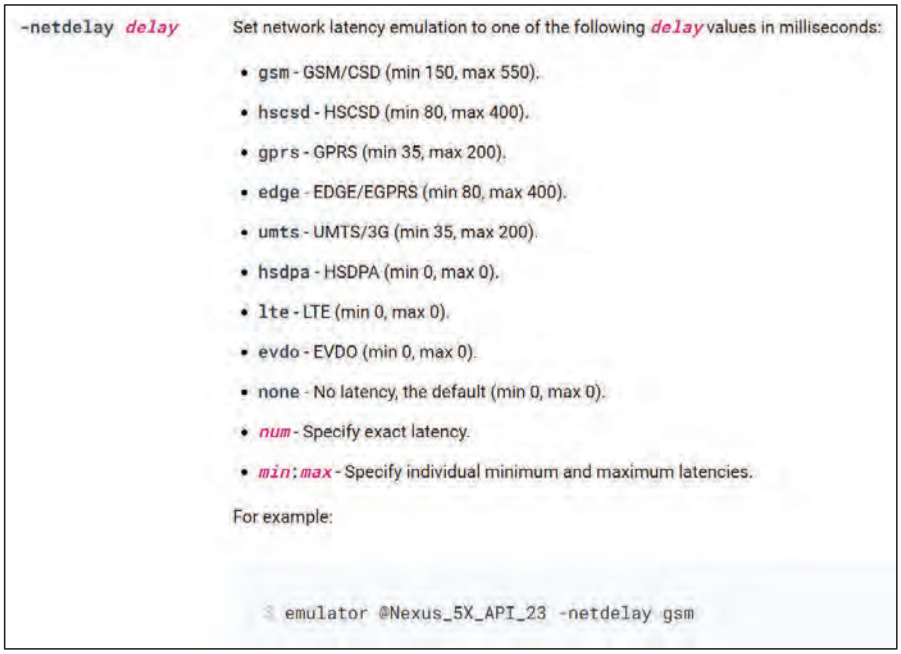
Sets the initial state of the simulated network transfer latency used by AVD. Latency is the delay in processing data across the network. The latency speed can also be adjusted in the emulator.

Screenshot from Android Studio Arctic Fox: Android Virtual Device (showing Network Latency options).

The network characteristics can also be controlled via the command-line options available for the Android Emulator, as illustrated below.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.



`-netdelay delay` Set network latency emulation to one of the following `delay` values in milliseconds:

- `gsm` - GSM/CSD (min 150, max 550).
- `hscsd` - HSCSD (min 80, max 400).
- `gprs` - GPRS (min 35, max 200).
- `edge` - EDGE/EGPRS (min 80, max 400).
- `umts` - UMTS/3G (min 35, max 200).
- `hsdpa` - HSDPA (min 0, max 0).
- `lte` - LTE (min 0, max 0).
- `evdo` - EVDO (min 0, max 0).
- `none` - No latency, the default (min 0, max 0).
- `num` - Specify exact latency.
- `min:max` - Specify individual minimum and maximum latencies.

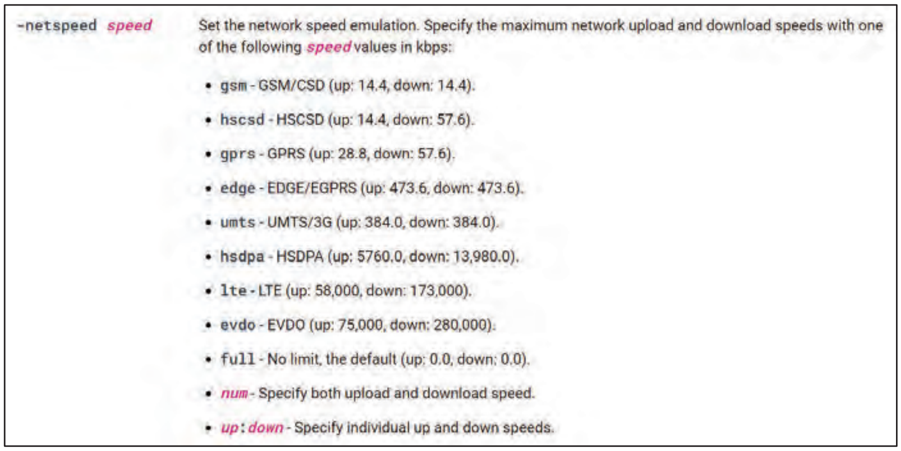
For example:

```
$ emulator @Nexus_5X_API_23 -netdelay gsm
```

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network latency properties).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

2[A] The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.



`-netspeed` *speed*

Set the network speed emulation. Specify the maximum network upload and download speeds with one of the following ***speed*** values in kbps:

- `gsm` - GSM/CSD (up: 14.4, down: 14.4).
- `hscsd` - HSCSD (up: 14.4, down: 57.6).
- `gprs` - GPRS (up: 28.8, down: 57.6).
- `edge` - EDGE/EGPRS (up: 473.6, down: 473.6).
- `umts` - UMTS/3G (up: 384.0, down: 384.0).
- `hsdpa` - HSDPA (up: 5760.0, down: 13,980.0).
- `lte` - LTE (up: 58,000, down: 173,000).
- `evdo` - EVDO (up: 75,000, down: 280,000).
- `full` - No limit, the default (up: 0.0, down: 0.0).
- *num* - Specify both upload and download speed.
- *up*:*down* - Specify individual up and down speeds.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network speed properties).

Claim 3

3[A] The system of claim 2, wherein the one or more connection simulations are configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.

Android Studio is configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.

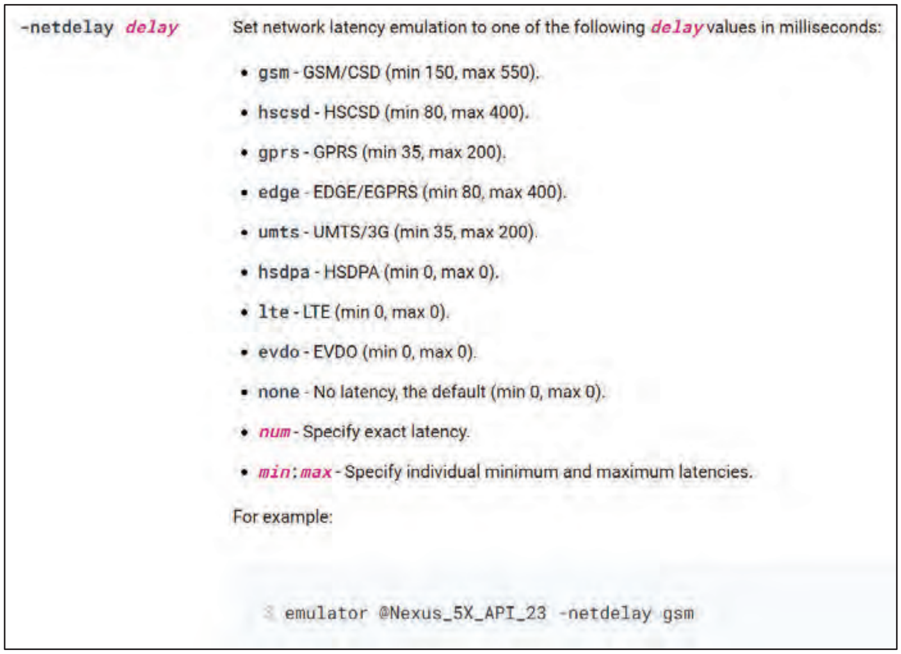
See 2[A].

For example, when a user selects a wireless network speed such as LTE, then the Emulator will simulate wireless transmission of content to the mobile device by simulating network characteristics that would occur in an LTE network when transmitting wireless content to the mobile device.

Claim 4

4[A] The system of claim 2, wherein the connection simulation includes one or more profiles.

Each connection simulation corresponds to a profile, e.g., the corresponding delay or bandwidth cap. *See* 2[A].



`-netdelay delay` Set network latency emulation to one of the following *delay* values in milliseconds:

- `gsm` - GSM/CSD (min 150, max 550).
- `hscsd` - HSCSD (min 80, max 400).
- `gprs` - GPRS (min 35, max 200).
- `edge` - EDGE/EGPRS (min 80, max 400).
- `umts` - UMTS/3G (min 35, max 200).
- `hsdpa` - HSDPA (min 0, max 0).
- `lte` - LTE (min 0, max 0).
- `evdo` - EVDO (min 0, max 0).
- none - No latency, the default (min 0, max 0).
- *num* - Specify exact latency.
- *min*:*max* - Specify individual minimum and maximum latencies.

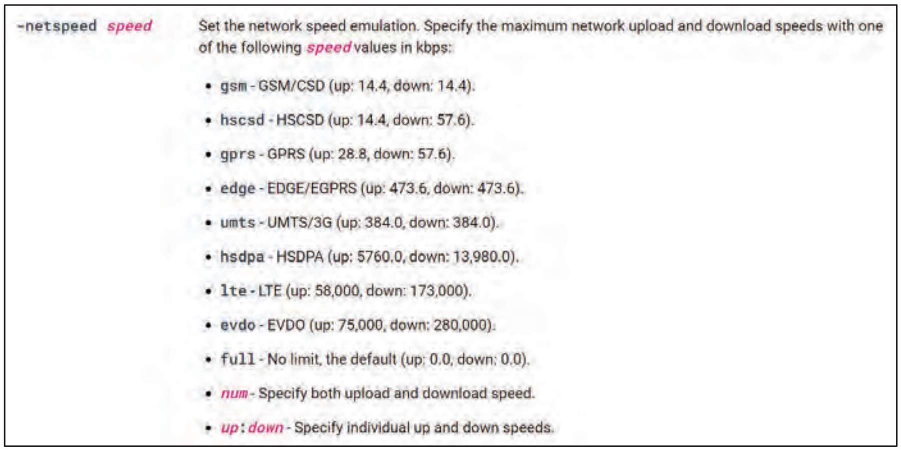
For example:

```
$ emulator @Nexus_5X_API_23 -netdelay gsm
```

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing delay values for network latency).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

4[A] The system of claim 2, wherein the connection simulation includes one or more profiles.



`-netspeed` *`speed`*

Set the network speed emulation. Specify the maximum network upload and download speeds with one of the following *speed* values in kbps:

- `gsm` - GSM/CSD (up: 14.4, down: 14.4).
- `hscsd` - HSCSD (up: 14.4, down: 57.6).
- `gprs` - GPRS (up: 28.8, down: 57.6).
- `edge` - EDGE/EGPRS (up: 473.6, down: 473.6).
- `umts` - UMTS/3G (up: 384.0, down: 384.0).
- `hsdpa` - HSDPA (up: 5760.0, down: 13,980.0).
- `lte` - LTE (up: 58,000, down: 173,000).
- `evdo` - EVDO (up: 75,000, down: 280,000).
- `full` - No limit, the default (up: 0.0, down: 0.0).
- *num* - Specify both upload and download speed.
- *up*`:`*down* - Specify individual up and down speeds.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing speed values for network speed).

Claim 5

5[A] The system of claim 4, wherein the profiles include preset profiles.

Each of the connection simulations listed in Android Studio for network speed (Full, LTE, HSDPA, UMTS, EDGE, GPRS, HSCSD, GSM) and network latency (None, UMTS, EDGE, GPRS) correspond to preset profile values as detailed above. See 4[A].

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

6[A] The system of claim 4, wherein the profiles are configured to enable a user to manage the profiles.

Claim 6

6[A] The system of claim 4, wherein the profiles are configured to enable a user to manage the profiles.

As detailed below, *see* 7[A], the profiles are configured to enable a user to create custom profiles. Creating custom profiles is a form of managing profiles.

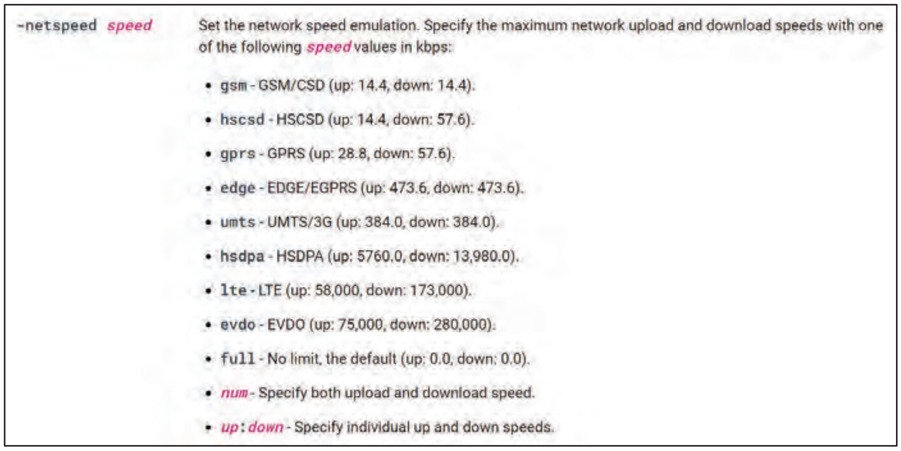
Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

7[A] The system of claim 4, wherein the profiles are configured to enable a user to create custom profiles.

Claim 7

7[A] The system of claim 4, wherein the profiles are configured to enable a user to create custom profiles.

Android Studio is configured to allow a user to create custom profiles by running the emulator from the command-line with the -netdelay and/or -netspeed options. These options allow a user to specify a minimum and maximum network latency as well as an upload and download speed for the simulated network connections.



`-netspeed` *`speed`*

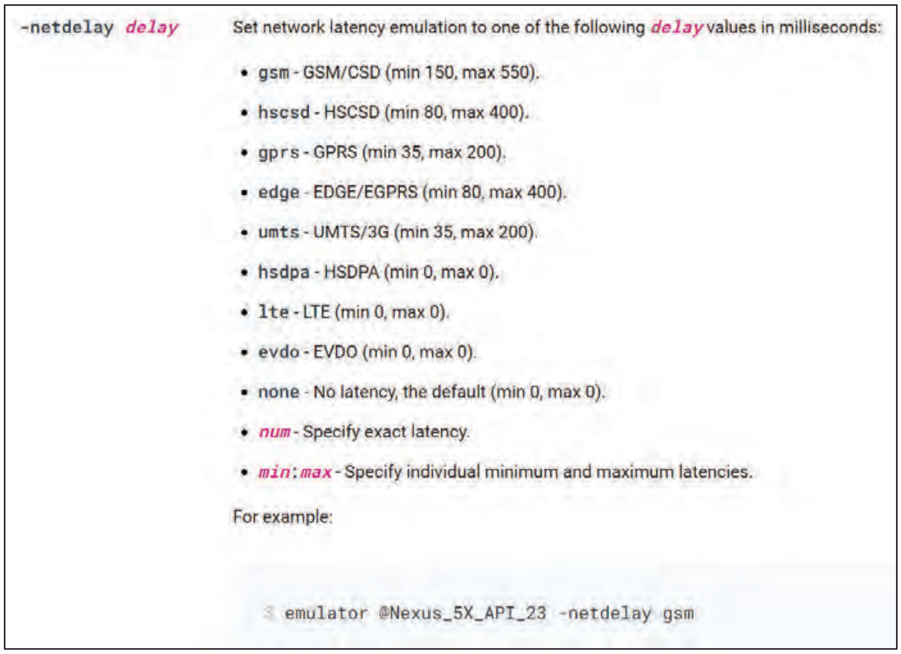
Set the network speed emulation. Specify the maximum network upload and download speeds with one of the following *speed* values in kbps:

- `gsm` - GSM/CSD (up: 14.4, down: 14.4).
- `hscsd` - HSCSD (up: 14.4, down: 57.6).
- `gprs` - GPRS (up: 28.8, down: 57.6).
- `edge` - EDGE/EGPRS (up: 473.6, down: 473.6).
- `umts` - UMTS/3G (up: 384.0, down: 384.0).
- `hsdpa` - HSDPA (up: 5760.0, down: 13,980.0).
- `lte` - LTE (up: 58,000, down: 173,000).
- `evdo` - EVDO (up: 75,000, down: 280,000).
- `full` - No limit, the default (up: 0.0, down: 0.0).
- *`num`* - Specify both upload and download speed.
- *`up`*`:`*`down`* - Specify individual up and down speeds.

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network speed properties).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

7[A] The system of claim 4, wherein the profiles are configured to enable a user to create custom profiles.



`-netdelay delay` Set network latency emulation to one of the following *delay* values in milliseconds:

- `gsm` - GSM/CSD (min 150, max 550).
- `hscsd` - HSCSD (min 80, max 400).
- `gprs` - GPRS (min 35, max 200).
- `edge` - EDGE/EGPRS (min 80, max 400).
- `umts` - UMTS/3G (min 35, max 200).
- `hsdpa` - HSDPA (min 0, max 0).
- `lte` - LTE (min 0, max 0).
- `evdo` - EVDO (min 0, max 0).
- `none` - No latency, the default (min 0, max 0).
- *num* - Specify exact latency.
- *min*:*max* - Specify individual minimum and maximum latencies.

For example:

```
$ emulator @Nexus_5X_API_23 -netdelay gsm
```

https://developer.android.com/studio/run/emulator-commandline (last visited 4/7/2024) (showing options for setting network latency properties).

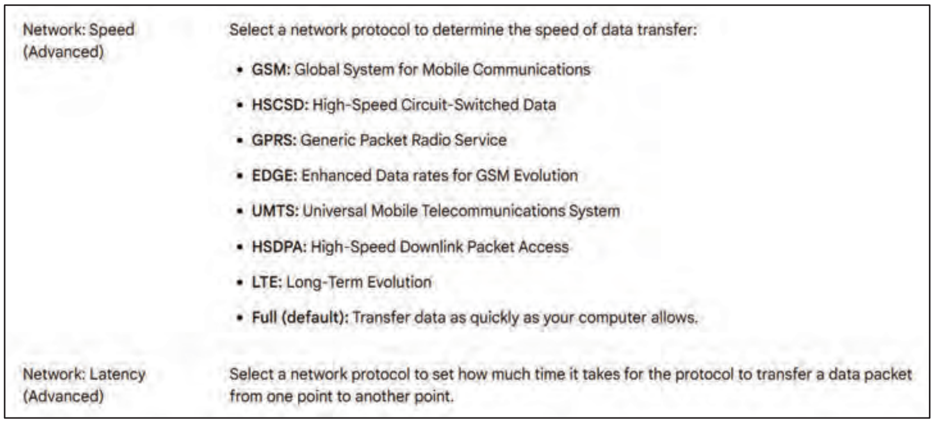
Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

9[A] The system of claim 2, wherein the one or more connection simulations are based on data of interaction with network operators in non-simulated environments.

Claim 9

9[A] The system of claim 2, wherein the one or more connection simulations are based on data of interaction with network operators in non-simulated environments.

The connection simulations of Android Studio are based on data of interaction with networks in non-simulated environments. The Network Speed and Latency settings offer a selection of specific protocols used in non-simulated network environments.



Network: Speed (Advanced)	Select a network protocol to determine the speed of data transfer: • **GSM:** Global System for Mobile Communications • **HSCSD:** High-Speed Circuit-Switched Data • **GPRS:** Generic Packet Radio Service • **EDGE:** Enhanced Data rates for GSM Evolution • **UMTS:** Universal Mobile Telecommunications System • **HSDPA:** High-Speed Downlink Packet Access • **LTE:** Long-Term Evolution • **Full (default):** Transfer data as quickly as your computer allows.
Network: Latency (Advanced)	Select a network protocol to set how much time it takes for the protocol to transfer a data packet from one point to another point.

https://developer.android.com/studio/run/managing-avds (last visited 4/20/2024). These protocols are built for use in non-simulated environments, notably, operator networks. Therefore, Android Studio's Network Speed and Latency settings are based on data of interaction with network operators in non-simulated environments.

See 1[C] (detailing interaction with network operators in non-simulated environments).

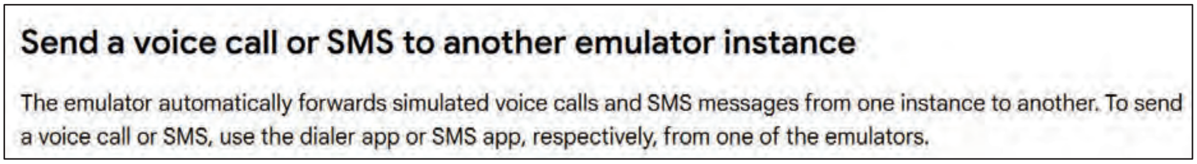
<u>**Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)**</u>

12[A] The system of claim 1, wherein the software is configured to allow a user to simulate an incoming sms message.

Claim 12

12[A] The system of claim 1, wherein the software is configured to allow a user to simulate an incoming sms message.

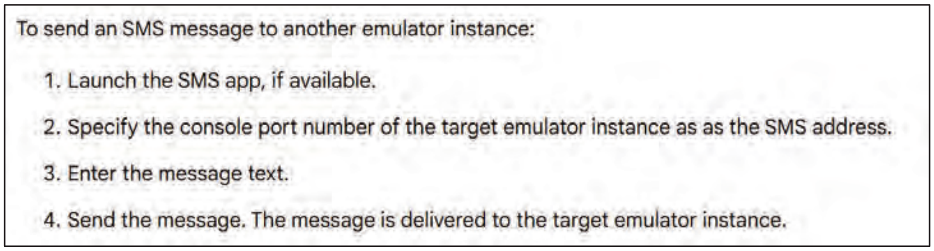
Android Studio is configured to allow a user to simulate an incoming sms message.



Send a voice call or SMS to another emulator instance

The emulator automatically forwards simulated voice calls and SMS messages from one instance to another. To send a voice call or SMS, use the dialer app or SMS app, respectively, from one of the emulators.

https://developer.android.com/studio/run/emulator-networking (last visited 4/20/2024).



To send an SMS message to another emulator instance:

1. Launch the SMS app, if available.
2. Specify the console port number of the target emulator instance as as the SMS address.
3. Enter the message text.
4. Send the message. The message is delivered to the target emulator instance.

https://developer.android.com/studio/run/emulator-networking (last visited 4/20/2024).

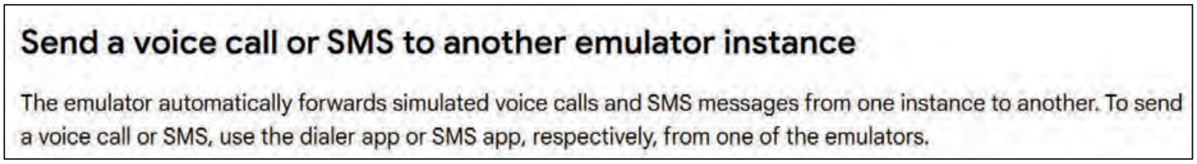
Infringement Chart for U.S. Patent No. 9,971,678 (Apple’s XCode Developer Tools)

13[A] The system of claim 1, wherein the software is configured to allow a user to simulate an incoming phone call.

Claim 13

13[A] The system of claim 1, wherein the software is configured to allow a user to simulate an incoming phone call.

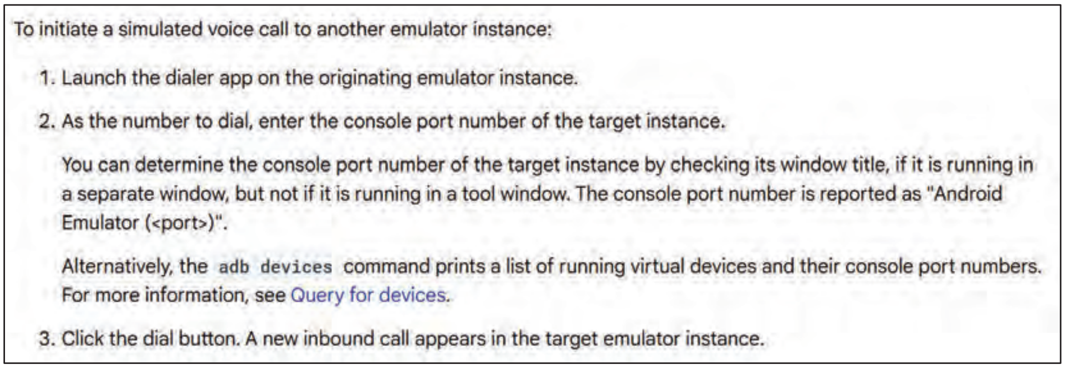
Android Studio is configured to allow a user to simulate an incoming phone call.



Send a voice call or SMS to another emulator instance

The emulator automatically forwards simulated voice calls and SMS messages from one instance to another. To send a voice call or SMS, use the dialer app or SMS app, respectively, from one of the emulators.

https://developer.android.com/studio/run/emulator-networking (last visited 4/20/2024).



To initiate a simulated voice call to another emulator instance:

1. Launch the dialer app on the originating emulator instance.
2. As the number to dial, enter the console port number of the target instance.

   You can determine the console port number of the target instance by checking its window title, if it is running in a separate window, but not if it is running in a tool window. The console port number is reported as "Android Emulator (<port>)".

   Alternatively, the `adb devices` command prints a list of running virtual devices and their console port numbers. For more information, see Query for devices.
3. Click the dial button. A new inbound call appears in the target emulator instance.

https://developer.android.com/studio/run/emulator-networking (last visited 4/20/2024).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

21[A] The system of claim 1, wherein the software is further configured to display data to identify application performance.

Claim 21

21[A] The system of claim 1, wherein the software is further configured to display data to identify application performance.

As discussed above for limitation 1[B].2 (and incorporated here by reference), the software is further configured to display data graphically which is configured to enable a user to identify application performance. For example, the graphical displays in Android's Profilers (CPU, memory, network, energy) and Network Inspector enable a user to identify either application performance. *See* 1[B] (showing profile display windows that display data graphically for Android Profilers and Network Inspector).

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

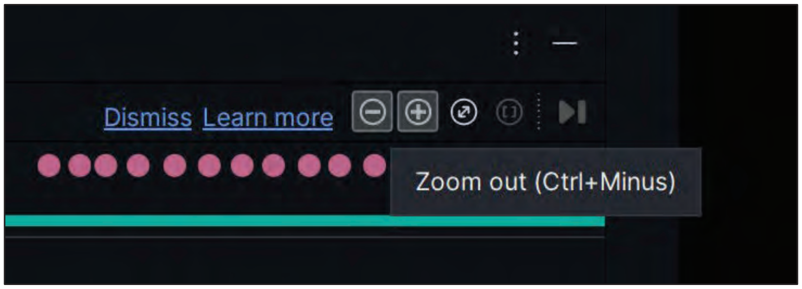
22[A] The system of claim 21, wherein the user can manage the data.

Claim 22

22[A] The system of claim 21, wherein the user can manage the data.

Android Studio permits users to manage the data provided by profilers.

For instance, the users can zoom in and zoom out of the data views.

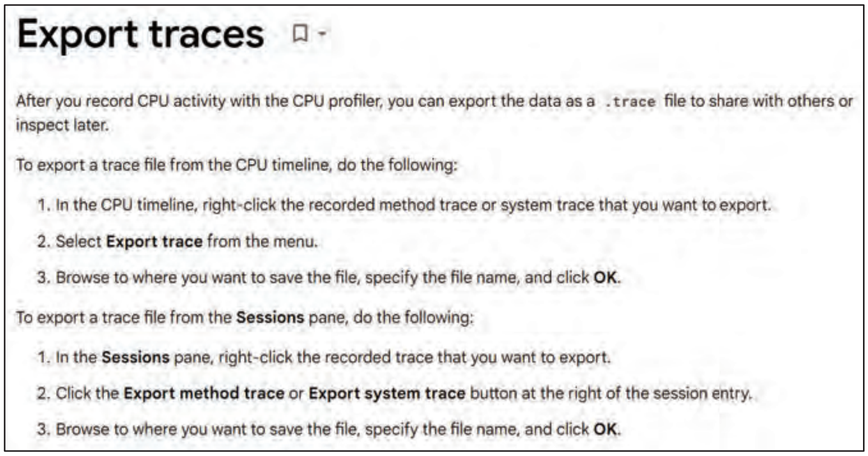


Screenshot from Android Studio Iguana: Profiler (illustrating Zoom Out, Zoom In, and Reset Zoom buttons for data display).

Additionally, users can export CPU and memory profiler data.

Infringement Chart for U.S. Patent No. 9,971,678 (Apple's XCode Developer Tools)

22[A] The system of claim 21, wherein the user can manage the data.



Export traces

After you record CPU activity with the CPU profiler, you can export the data as a `.trace` file to share with others or inspect later.

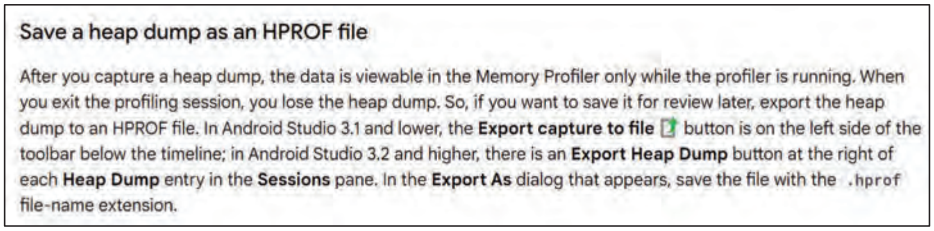
To export a trace file from the CPU timeline, do the following:

1. In the CPU timeline, right-click the recorded method trace or system trace that you want to export.
2. Select **Export trace** from the menu.
3. Browse to where you want to save the file, specify the file name, and click **OK**.

To export a trace file from the **Sessions** pane, do the following:

1. In the **Sessions** pane, right-click the recorded trace that you want to export.
2. Click the **Export method trace** or **Export system trace** button at the right of the session entry.
3. Browse to where you want to save the file, specify the file name, and click **OK**.

https://developer.android.com/studio/profile/export-traces (last visited 5/1/2024).



Save a heap dump as an HPROF file

After you capture a heap dump, the data is viewable in the Memory Profiler only while the profiler is running. When you exit the profiling session, you lose the heap dump. So, if you want to save it for review later, export the heap dump to an HPROF file. In Android Studio 3.1 and lower, the **Export capture to file** button is on the left side of the toolbar below the timeline; in Android Studio 3.2 and higher, there is an **Export Heap Dump** button at the right of each **Heap Dump** entry in the **Sessions** pane. In the **Export As** dialog that appears, save the file with the `.hprof` file-name extension.

https://developer.android.com/studio/profile/memory-profiler (last visited 5/1/2024).